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LEVEL II

THE STRESS BEHAVIOR OF THREE ADVANCED NICKEL-BASE SUPERALLOYS DURING HIGH-TEMPERATURE, LOW-CYCLE FATIGUE

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This report is a compilation of data on stress behavior as a function of cycles obtained during high-temperature, low-cycle fatigue tests on three advanced Ni-base superalloys--René 95, AF-115, and AF2-1DA. The data are presented in both tabular and graphical formats. The materials studied are those used for jet-engine turbine disks, and the fatigue tests were conducted at their operating temperatures. The purpose of this report is to make the test data available to the technical community. No discussion is presented on an analysis or an understanding of the data, although some observations are included.

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FOREWORD

This report was prepared by the Research Applications Division of Systems Research Laboratories, Inc., Dayton, OH, under Contract No. F33615-76-C-5191, "Mechanical Peoperty Testing and Materials Evaluation." The contract was initiated under Project No. 7351, Task No. 735106, and was administered under the direction of the Materials Laboratory, Metals Behavior Branch (AFWAL/MLLN), with Dr. Theodore Nicholas as the Government Project Monitor. The information reported here was collected and prepared by H. L. Bernstein during the period January 1977 through August 1978. The author wishes to thank Dr. J. M. Hyzak, formerly of the Materials Laboratory, Dr. T. Nicholas of the Materials Laboratory, and Dr. N. Ashbaugh of Systems Research Laboratories, Inc., for their support of this work. Special thanks go to Messrs. D. Deaton and G. Bullmaster for the long, tedious hours spent reducing and plotting the data; to Mar-Test, Inc., for performing the fatigue tests; and to Mrs. Judy Paine for typing the manuscript.

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SECTION 1

INTRODUCTION

This report is a compilation of data on stress behavior as a function of cycles obtained during high-temperature, low-cycle fatigue tests on three advanced Ni-base superalloys--René 95, AF-115, and AF2-1DA. The data are presented in both tabular and graphical formats. The materials studied are those used for jet-engine turbine disks, and the fatigue tests were conducted at the operating temperatures of the three materials -- 1200°F, 1400°F and 1400°F, respectively. The purpose of this report is to make the basic test data available to the technical community. No discussion is presented on an analysis or understanding of the data, although some observations are included. The data in this report are a subset of a larger data base. A summary of this data base is given in Ref. 1. The cyclic stress behavior reported here was determined for characteristic tests in this larger data base. Since recording the stress behavior is a very time-consuming and tedious process, not all of the fatigue tests could be analyzed.

The larger data base has been the subject of other studies. Analysis of various life-prediction methods using the René 95 data is given in Refs. 2 - 4. A discussion of the mechanisms of high-temperature, low-cycle fatigue for AF-115 and AF2-1DA can be found in Ref. 5.

SECTION 2

DESCRIPTION OF MATERIALS AND SPECIMEN IDENTIFICATION AND GEOMETRY

The materials tested were René 95, AF-115, and AF2-1DA. The René 95 was in the form of two cast and wrought pancakes which underwent thermo-mechanical processing. These were cut from the same ignot and subjected to the same processing. The specimens from the first pancake are identified by a one- or two-digit number such as 9 or 35. Those from the second pancake are identified by a three-digit number in the 200 series such as 220. No difference in fatigue lives or stress-strain behavior between the two pancakes was found. Details of the processing history and microstructure are given in Refs. 6 and 7.

The AF-115 is a powder alloy that has been hot isostatically pressed (HIP). Two different forms of AF-115 were used--one being as-HIP and the other a HIP-and-forged product. The HIP-and-forged product came from the same ignot as the as-HIP product. The specimen labels for these pancakes are given in Table 1. Each specimen had more than one label. Details of the processing and microstructure of these pancakes are given in Refs. 1 and 5.

The AF2-1DA is also a powder alloy but instead of being HIP, it has been superplastically forged (Gatorized). Two pancakes from the same ignot and receiving the same processing treatments were used. Specimens from the first pancake are identified by a number in the 100 series and those from the second, by a number in the 200 series. Table 1 gives alternate designations for the same specimen. The processing and microstructure of AF2-1DA is discussed in Refs. 1 and 5.

The geometry of the fatigue specimens for the AF-115 and AF2-1DA was of the uniform cylindrical type, having 0.25-in. diam. and 0.75-in. length in the gage section. The René 95 specimens were of the hourglass design, with 0.25-in. minimum diameter.

TABLE 1

SPECIMEN IDENTIFICATION

René 95	example
XX - first pancake	19
2XX - second pancake	225

AF-115	example
2XX or 2-XX - as-HIP	202 or 2-2
5XX or 5-XX - HIP and forged	503 or 5-3

AF2-1DA	example
1XX or B1-XX - first pancake	105 or B1-5
2XX, 2-XX, - second pancake* or 3XX	215 or 2-15 216 or 3-16

*2-XX is from 2-1 to 2-15; 3-XX is from 3-16 and beyond.

SECTION 3
FATIGUE TESTS AND NOMENCLATURE

The fatigue tests consisted mainly of continuous-cycling and strain-hold tests. The continuous-cycling tests were run at frequencies from 20 to 0.05 cycles per minute (cpm). The hold periods of the strain-hold tests were 1 and 10 min. and occurred in both tension and compression. Some other tests--fast-slow, slow-fast, and intermediate strain-hold--were performed using the René 95. A summary of the test conditions and nomenclature is given in Table 2 and in Fig. 1. Although Table 2 contains only the waveforms for the René 95 tests, it is a relatively simple matter to add the test waveforms which were applied to the other alloys. In addition, Fig. 1 shows only an A-ratio* of infinity. Other A-ratios will shift the origin of the axis in Fig. 1, but the basic waveshapes will be retained.

The nomenclature used for the waveforms is relatively straightforward. The continuous-cycling tests are identified by the test frequency. A test run at 20 cycles per minute is called a "20-cpm" test. The strain-hold tests are identified by the time of the hold. A two-digit code, x/y, is used, with x being the amount of time spent in a tensile hold at maximum strain and y the amount of time in a compressive hold at minimum strain. For example, "1/0" means a one-minute hold in tension only, and "1/10" means a one-minute hold in tension and a ten-minute hold in compression.

The slow-fast (S/F) and fast-slow (F/S) tests are specified by the frequencies of the slow and fast strain rates. A slow-fast test having a strain rate corresponding to a frequency of 0.05 cycles per minute from minimum to maximum strain and a strain rate corresponding to a frequency of 20

*A-ratio = alternating strain divided by mean strain.

cycles per minute from maximum to minimum strain is called a "0.05-20 cpm" test. For some of these tests, the "½" which separates the two numbers -- 0.05-½-20cpm -- indicates that the strain rate was changed from the fast rate to the slow rate halfway between the peak-strain and the zero-strain levels, as shown in Fig. 1.

The intermediate strain-hold tests are identified by an "I" preceding the hold time, i.e., "I1/0". In this test the strain is held for one minute intermediate between the peak compressive and tensile strains.

The fatigue tests were performed by Mar-Test, Inc., using servo-hydraulic fatigue machines. The tests were controlled by the measured axial strain for the AF-115 and AF2-1DA and by a computed axial strain for the René 95. This computed axial strain was determined from the diametral strain through the use of an analog strain computer. Details of the specimen geometry and test procedure can be found in Refs. 8 and 9.

The fatigue tests were conducted at the operating temperature of the material. These temperatures were 1200°F for René 95 and 1400°F for both AF-115 and AF2-1DA.

In all but one of the 20-cpm tests, the load was gradually increased until the desired strain level was reached. An example of gradual loading is shown for Test #22 in Fig. 2. This gradual loading was used in order to avoid overshooting the desired strain limits. The point at which full strain was reached is indicated in the plots and tables of data. The one test where this gradual loading was not used was Test No. 240. In this test the desired strain limit was reached on the first cycle.

In all the fatigue tests, slight adjustments to the control setting were made during the first few cycles to achieve the desired strain level.

For the René 95 data, the stresses near the end of the life of the specimen were dependent upon the location of the tips of the extensometer with respect to the position of the fatigue crack on the specimen. This behavior was due to the hourglass geometry of the René 95 specimens. When the extensometer tip was on the same side as the crack, then the tensile stress rose. If the tip and crack were 90° apart, then this stress dropped. The behavior of the compressive stress is not so well understood.

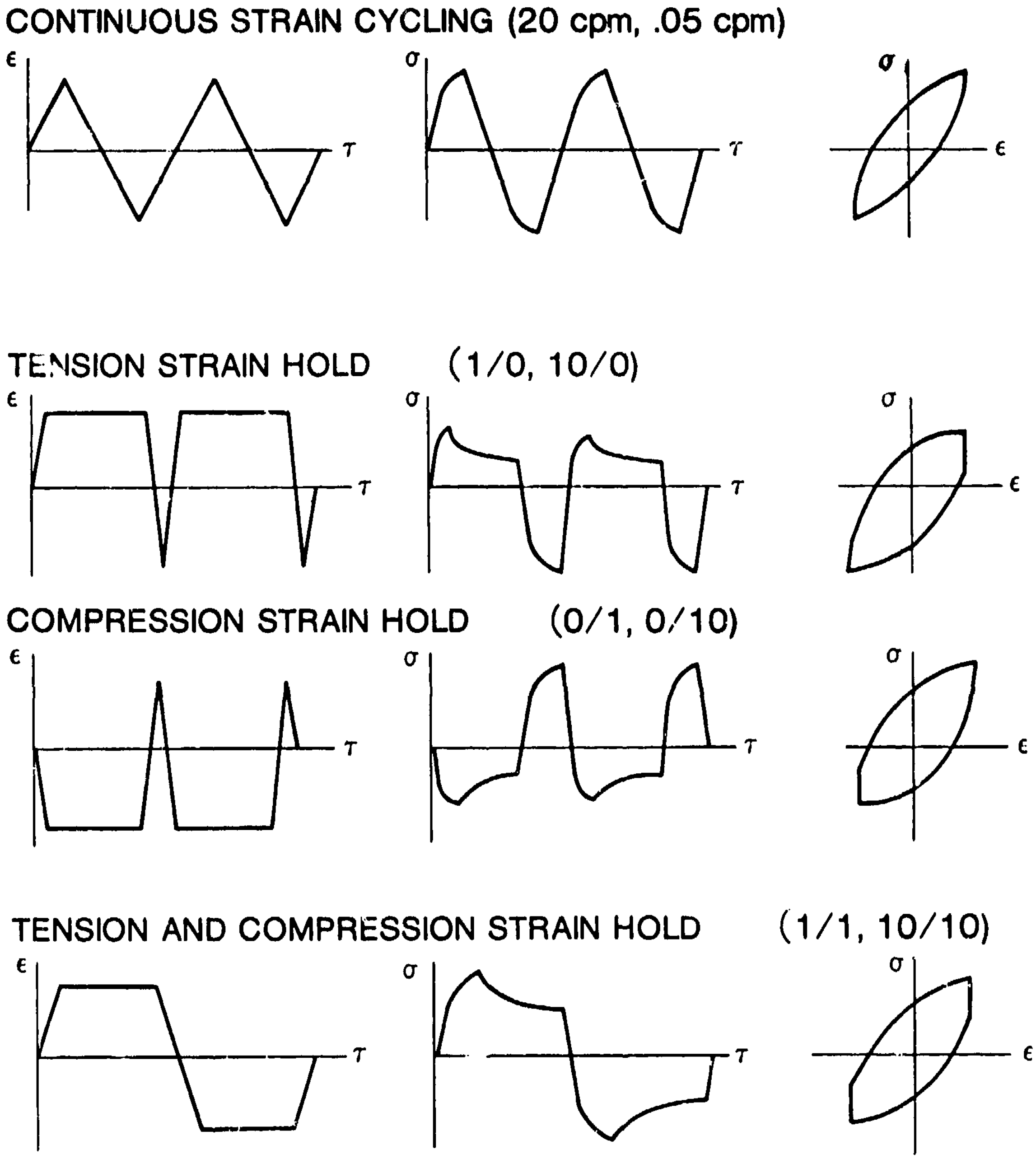


Figure 1. Waveforms and Hysteresis Loops of Fatigue Tests

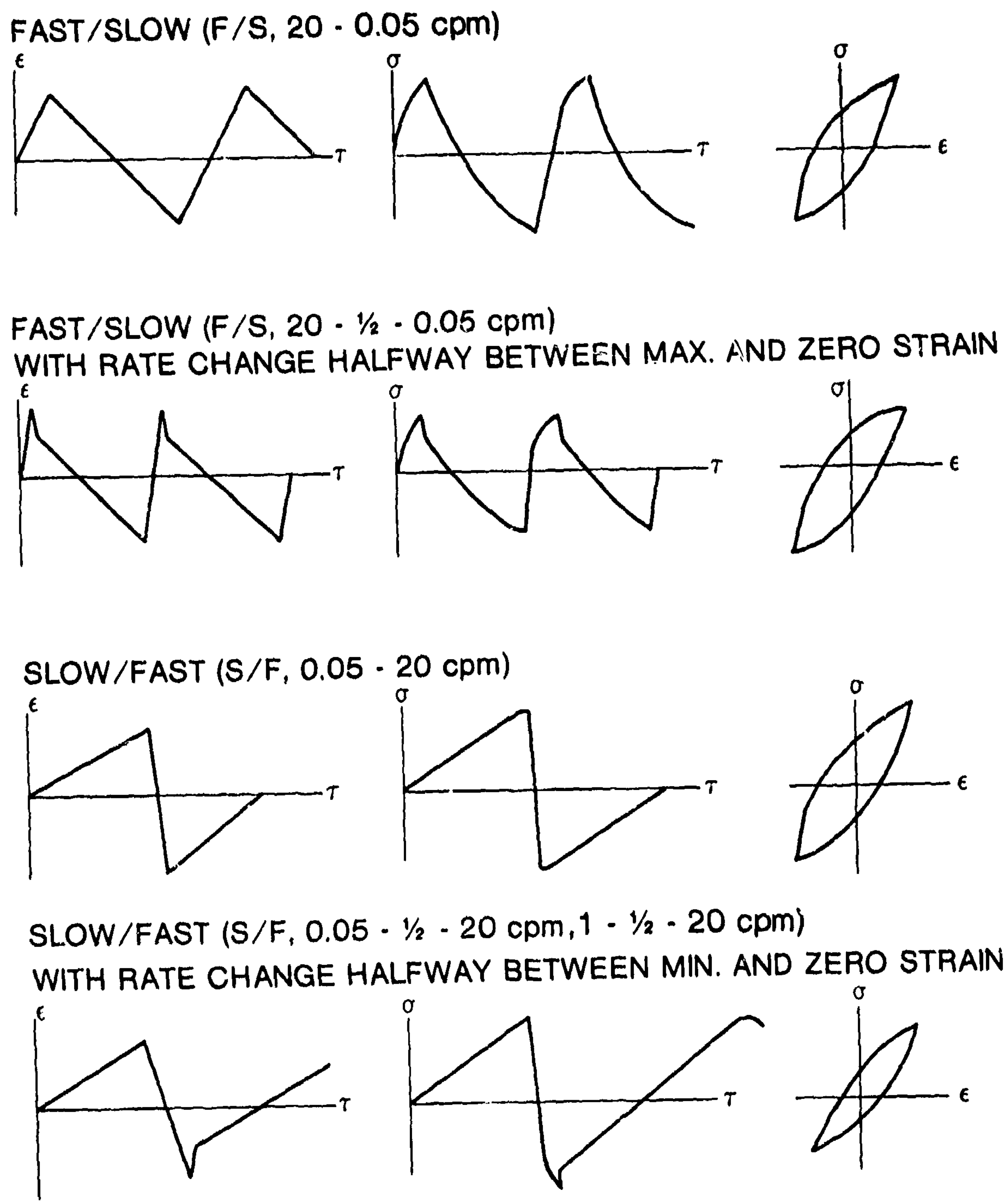


Figure 1 (continued)

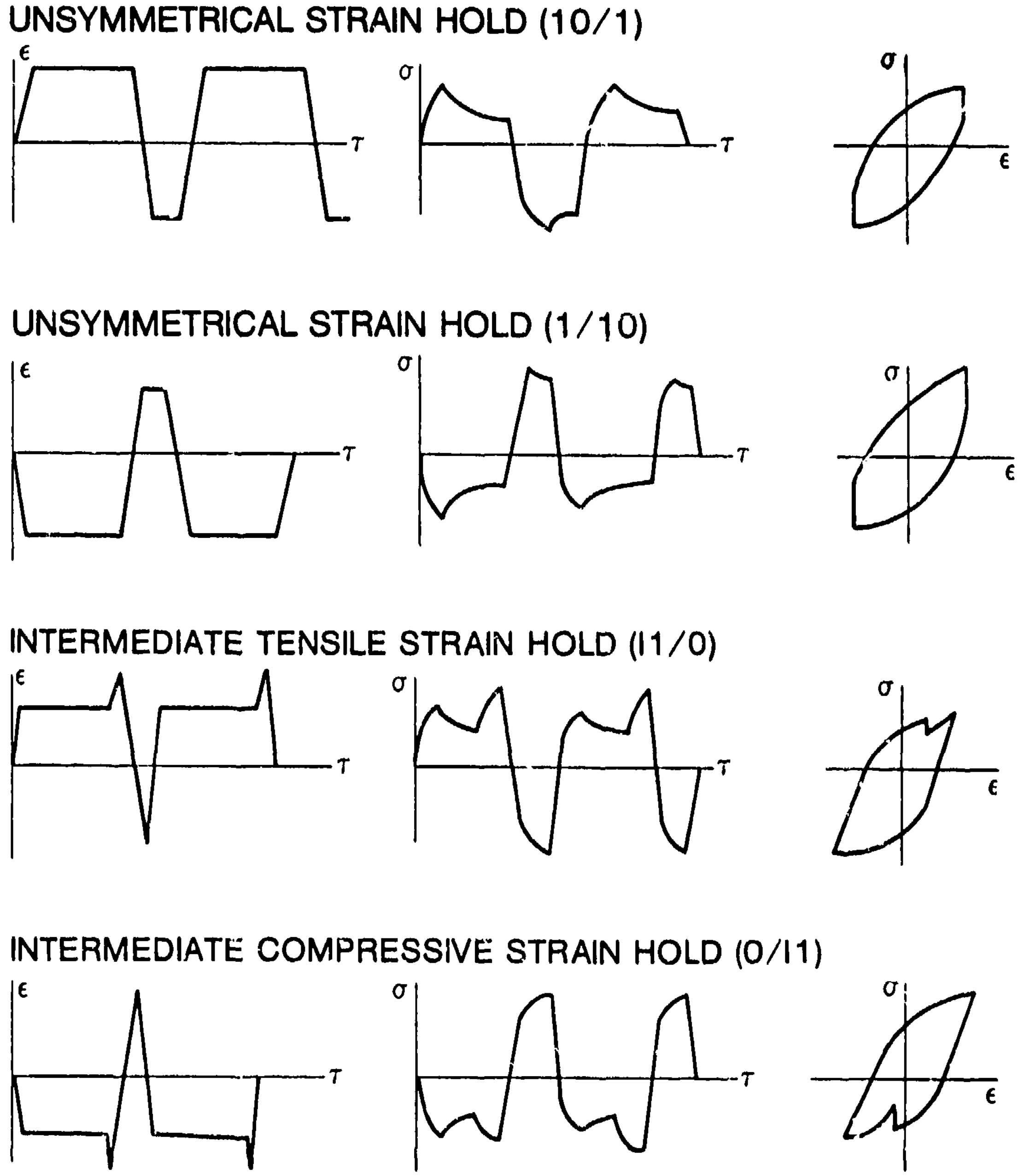


Figure 1 (continued)

TABLE 2

WAVEFORMS AND NOMENCLATURE FOR FATIGUE TESTS

Symbol	Description
20 cpm	Continuous cycling at a frequency of 20 cycles/min. or 3 sec/cycle.
0.05 cpm	Continuous cycling at a frequency of 0.05 cycles/min. or 20 min./cycle. In all but one of these tests, the plastic strain was the controlled variable.
1-0	1-min. hold time at maximum strain in tension. 20-cpm ramps for the strain reversals.
10-0	As in 1-0, except 10-min. hold time instead of 1 min.
0-1	1-min. hold time at maximum strain in compression. 20-cpm ramps for the strain reversals.
0-10	As in 0-1, except 10-min. hold time instead of 1 min.
1-1	1-min. hold time at maximum strain both in tension and compression. 20-cpm ramps for the strain reversals.
10-10	As in 1-1, except 10-min. hold instead of 1 min.

TABLE 2 (Continued)

Symbol	Description
20-0.05 cpm (or F/S)	Continuous cycling at two frequencies. The positive strain rate was 20-cpm, and the negative strain rate was 0.05-cpm. The changes in strain rate occurred at the peak tensile and compressive strains.
20-1/2-0.05 cpm (or F/S)	As in 20-0.05-cpm, except the change from the fast to the slow strain rate occurred halfway between the peak tensile strain and zero strain.
0.05-20-cpm (or S/F)	Continuous cycling at two frequencies. The positive strain rate was 0.05-cpm, and the negative strain rate was 20-cpm. The changes in strain rate occurred at the peak tensile and compressive strains.
0.05-1/2-20 cpm (or S/F)	As in 0.05-20-cpm, except the change from the fast to the slow strain rate occurred halfway between the peak compressive strain and zero strain.
1-1/2-20 cpm (or S/F)	As in 0.05-1/2-20-cpm, except the slow strain rate was 1-cpm.
I1-0	1-min. hold time before the peak tensile strain. 20-cpm ramps for the strain reversals.
0-I1	1-min. hold time before the peak compressive strain. 20-cpm ramps for the strain reversals.
10-1	10-min. hold time at the peak tensile strain and 1-min. hold time at the peak compressive strain. 20-cpm ramps for the strain reversals.
1-10	1-min. hold time at the peak tensile strain and 10-min. hold time at the peak compressive strain. 20-cpm ramps for the strain reversals.

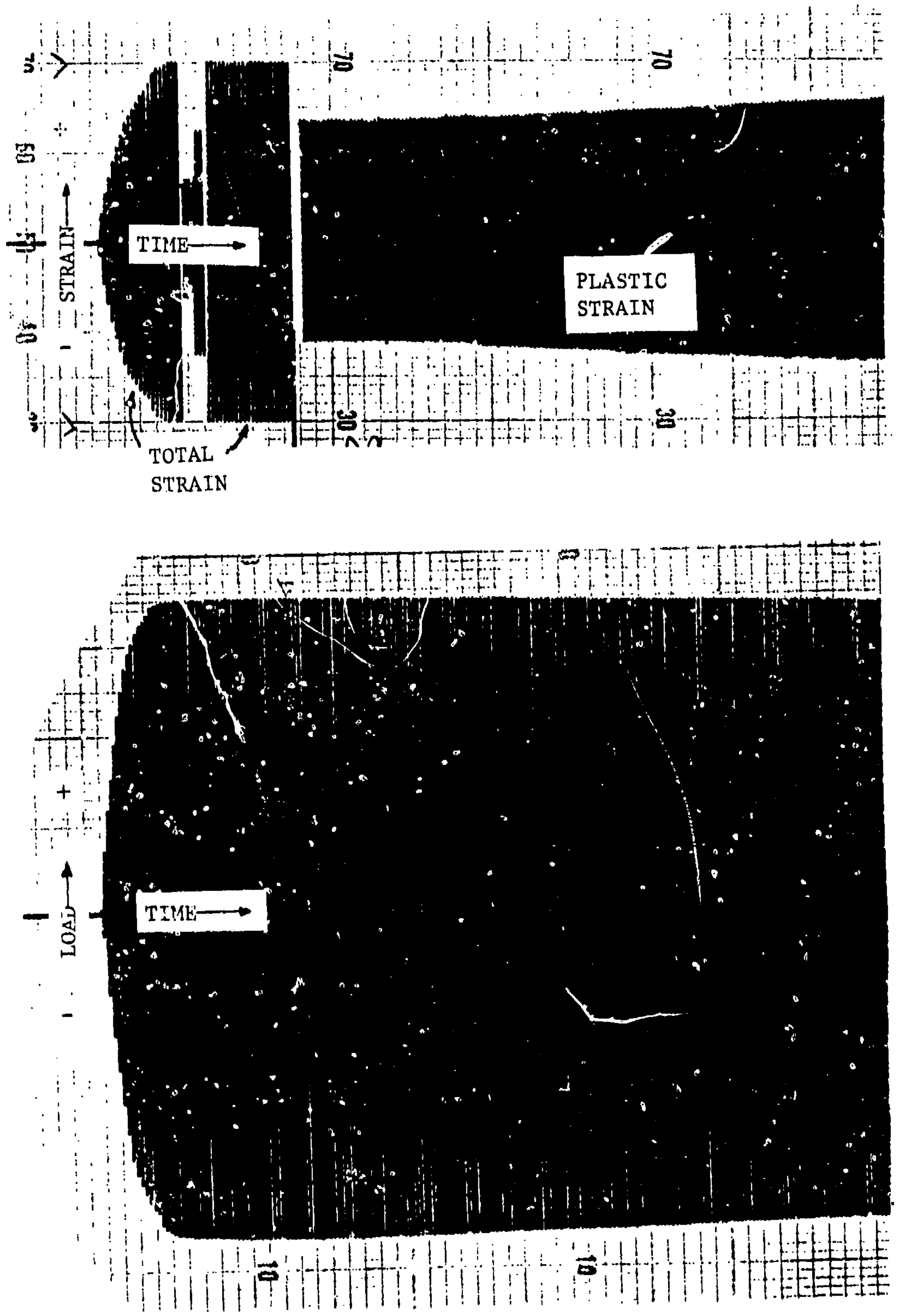


Figure 2 Loading of Specimen No. 22

SECTION 4

DATA REDUCTION

The stress was continuously recorded on strip-chart recorders during the fatigue tests. After the test, the time base of these strip-chart records was converted to cycles. Then, the value of the stresses was read by eye from the chart at either a predetermined number of cycles (such as every one hundred cycles) or whenever the value of stress changed significantly. These numbers were punched onto computer cards, and the tables and graphs were prepared after suitable computer programs had been written.

SECTION 5

DESCRIPTION OF TABLES AND GRAPHS

A summary of the basic test parameters for the tests in this report is given in Tables 3 - 5. In these tables all stresses and strains are measured at one-half of the specimen life, unless otherwise indicated. The total strainrange is a nominal value, making it easier to identify and compare tests. The actual value varied by ± 0.01% in strain from the nominal value, i.e., a test at 1.20% total strain could be either 1.19 or 1.21%.

The stress behavior during the test is generally presented in three forms--one tabular and two graphical. The tables present the number of cycles (N), the percent of life* (%N), and the stresses (σ) (in ksi). In the graphs the data are plotted as stress vs percent of life and as stress vs the logarithm of the number of cycles. For most of the René 95 tests, all three forms of data are presented. Those tests where one form is missing are so indicated in Table 3. No graphs were made for the AF-115 and AF2-1DA data.

The René 95 data are organized into five sections--continuous-cycling tests (Section 7), slow-fast and fast-slow tests (Section 8), tensile-only strain-hold tests (Section 9), compressive-only strain-hold tests (Section 10) and tensile-compressive strain-hold tests (Section 11). Within each section, the data for each test are given in a table, followed by plots of σ vs % N and σ vs log N. The AF-115 and AF2-1DA data are given separately in Sections 12 and 13, respectively.

The tables of stress behavior are fairly self-explanatory. The column labeled "I" is merely a sequential numbering of the data. The columns labeled "Relaxed" contain the amount of stress relaxed during a hold period.

*%N = (N/N_f) *100, where N_f is the cycles to failure.

The amount relaxed in a tensile strain-hold follows the column labeled tensile and likewise for compression. The "Relaxed" columns are used for different purposes for the fast-slow and slow-fast tests, and the purpose is indicated in those tables. The tables containing intermediate-hold data have an additional column labeled "Held Tensile" or "Held Compr." This column gives the stress at which the hold period began. The "Relaxed" column has the same use for these tests as for the other strain-hold tests. Blank spaces in the tabular data indicate that the value could not be measured.

In the plots the same nomenclature as for the tables is used. The graphs clearly point out the gradual loading of the 20-cpm tests. The point at which the strain limits were reached is indicated on the graphs as well as in the tables.

TABLE 3

RENE 95 DATA

SPEC. NO.	TYPE OF TEST	A-RATIO [a]	TOTAL STRAIN -RANGE (%) [b]	CYCLES TO FAILURE [c]	INEL. STRAIN -RANGE (%)	MAX. TENSILE STRESS (KSI)	MAX. COMPR. STRESS (KSI)	RELAXED TENSILE STRESS (KSI) [d]	RELAXED COMPR. STRESS (KSI) [d]	STRESS AT HOLD PERIOD (KSI) [e]	STRAIN AT HOLD PERIOD (%) [e]	TIME TO FAILURE (HOURS)
17 [ℓ]	20CPM	INTY	2.00	234	.53300	178.0	195.0	0.00	0.00	0.0	0.00	.20
18 [ℓ]	20CPM	INTY	1.80	307	.41800	175.0	186.0	0.00	0.00	0.0	0.00	.26
22	20CPM	INTY	1.60	461	.31100	165.0	173.0	0.00	0.00	0.0	0.00	.38
240	20CPM	INTY	1.60	463	.23500	161.1	173.5	0.00	0.00	0.0	0.00	.39
27	20CPM	INTY	1.20	1629	.11400	140.0	145.6	0.00	0.00	0.0	0.00	1.36
234 [m,n]	20CPM	INTY	.90	19160	.01300	99.0	133.8	0.00	0.00	0.0	0.00	15.97
235 [m,n]	20CPM	INTY	.90	22364	.00850	93.2	129.2	0.00	0.00	0.0	0.00	18.64
264	20CPM	+1/5	1.20	752	.06500	183.3	190.4	0.00	0.00	0.0	0.00	.53
36	20CPM	+1	1.20	1207	.03800	160.8	129.0	0.00	0.00	0.0	0.00	1.01
37	20CPM	-1	1.20	2126	.03500	115.0	168.0	0.00	0.00	0.0	0.00	1.77
26 [f,ℓ]	.05CPM	INTY	1.60	301	.25000	161.0	179.0	0.00	0.00	0.0	0.00	101.29
34 [ℓ]	.05CPM	INTY	1.30	526	.12000	137.0	165.0	0.00	0.00	0.0	0.00	175.33
251	20-.05CPM	INTY	1.40	636	.09850 [G]	161.0	177.0	0.00	0.00	161.0	.70	114.64
262	20-½-.05CPM	INTY	1.20	1086	.04700	144.0	147.0	0.00	0.00	67.5	.29	181.45
252 [h]	.05-20CPM	INTY	1.40	194	.05645 [G]	166.0	175.0	0.00	0.00	-175.0	-.70	32.23
263 [h]	.05-20CPM	INTY	1.40	238	.11500	160.0	169.2	0.00	0.00	-169.0	-.70	39.83
257 [i,m]	20-½-.05CPM	INTY	.97	5286 [R]	.04500	145.0	90.0	0.00	0.00	-26.0	****j	833.10
5	1-0	INTY	1.80	255	.52200	161.0	187.0	19.10	0.00	0.0	0.00	4.47
10	1-0	INTY	1.60	257	.23700	160.0	191.0	8.90	0.00	0.0	0.00	4.51
7	1-0	INTY	1.40	748	.21600	138.0	178.0	8.00	0.00	0.0	0.00	13.39
12	1-0	INTY	1.20	1289	.09330	123.0	156.0	1.50	0.00	0.0	0.00	23.02
39	1-0	INTY	1.10	1781	.03900	108.0	154.0	4.80	0.00	0.0	0.00	31.17
38	1-0	INTY	1.00	5313	.04900	101.0	148.0	1.50	0.00	0.0	0.00	87.72
233	1-0	INTY	1.00	6519	.05050	89.3	158.4	1.90	0.00	0.0	0.00	114.38
33	1-0	INTY	1.00	9609	.03300	82.8	159.0	.51	0.00	0.0	0.00	168.15
237 [m,n]	1-0	INTY	.90	16418	.04590	73.3	151.9	1.20	0.00	0.0	0.00	287.31
228	10-0	INTY	1.40	481	.15500	130.0	191.0	7.56	0.00	0.0	0.00	80.57
40	10-0	INTY	1.20	1705	.12600	105.0	175.0	6.20	0.00	0.0	0.00	285.58

Explanation of footnotes at end of table.

TABLE 3

RENE 95 DATA Continued

SPEC. NO.	TYPE OF TEST	A-[a] RATIO	TOTAL STRAIN -RANGE (%)[b]	CYCLES TO FAILURE[c]	INEL. STRAIN -RANGE (%)	MAX. TENSILE STRESS (KSI)	MAX. COMPR. STRESS (KSI)	RELAXED TENSILE STRESS (KSI)[d]	RELAXED COMPR. STRESS (KSI)[d]	STRESS AT HOLD PERIOD (KSI)[e]	STRAIN AT HOLD PERIOD (%)[e]	TIME TO FAILURE (HOURS)
242	I1-0	INTY	1.80	472	.42220	163.0	186.0	13.00	0.00	155.0	.60	8.28
246	I1-0	INTY	1.80	253	.41200	172.0	190.0	16.50	0.00	144.0	.70	4.43
244	I1-0	INTY	1.60	447	.25640	154.0	181.0	16.00	0.00	144.0	.70	7.81
232[k,m,n]	I1-0	+7	1.40	775	.11330	167.1	170.1	2.20	0.00	122.9	.60	13.56
6	0-1	INTY	1.80	207	.42900	178.0	181.0	0.00	15.30	0.0	0.00	3.50
11	0-1	INTY	1.60	239	.45800	162.0	161.0	0.00	15.53	0.0	0.00	3.66
14	0-1	INTY	1.60	219	.32400	177.0	174.0	0.00	10.70	0.0	0.00	3.33
8	0-1	INTY	1.40	413	.19200	165.0	158.0	0.00	6.20	0.0	0.00	7.30
13	0-1	INTY	1.20	846	.03790	156.0	140.0	0.00	2.30	0.0	0.00	14.80
16	0-1	INTY	1.00	3093	.01030	124.0	123.0	0.00	.40	0.0	0.00	54.12
231[o]	0-1	-1	.90	5185	.02200	94.6	129.4	0.00	0.00	129.4	0.00	90.74
222	0-10	INTY	1.40	224	.13590	175.0	155.0	0.00	5.55	0.0	0.00	37.52
41	0-10	INTY	1.20	283	.18500	154.0	117.0	0.00	14.80	0.0	0.00	47.40
247	0-I1	INTY	1.80	263	.35590	172.0	185.0	0.00	14.70	156.0	-.70	4.60
1	1-1	INTY	1.80	156	.53030	181.0	195.0	28.60	21.60	0.0	0.00	5.29
2	1-1	INTY	1.60	238	.34910	170.0	184.0	18.60	14.00	0.0	0.00	8.37
32	1-1	INTY	1.40	358	.23130	150.0	172.0	9.70	7.10	0.0	0.00	12.13
9	1-1	INTY	1.20	959	.12200	135.0	154.0	7.50	8.90	0.0	0.00	32.48
4	1-1	INTY	1.00	1215	.11600	120.0	134.0	10.80	6.70	0.0	0.00	41.52
15	1-1	INTY	1.00	1288	.07800	117.0	136.0	5.20	5.10	0.0	0.00	43.55
229	1-1	INTY	.95	5277	.02450	95.2	128.0	0.00	0.90	0.0	0.00	179.42
26	10-10	INTY	1.80	115	.73100	179.0	193.0	54.60	47.70	0.0	0.00	38.41
31	10-10	INTY	1.40	199	.43700	158.0	171.0	49.00	43.10	0.0	0.00	65.35
227	10-1	INTY	1.40	455	.23210	144.0	176.0	23.80	13.20	0.0	0.00	83.30
223	10-1	INTY	1.20	945	.13850	118.0	164.0	11.60	5.30	0.0	0.00	174.93
224	1-10	INTY	1.40	349	.22100	165.0	161.0	15.90	13.70	0.0	0.00	64.27
225	1-10	INTY	1.20	464	.15170	150.0	140.0	12.20	10.60	0.0	0.00	85.45

Explanation of footnotes on following page.

TABLE 3 Continued

[a]INTY = infinity; nominal value of the A-ratio is given.

[b]Nominal value.

[c]The suffix "R" indicates a runout.

[d]Relaxed tensile stress is the difference between the tensile stress at the beginning and the end of the hold period.

[e]The stress and strain at hold period are the stress and strain at the beginning of the hold period for the intermediate hold tests; however, for the slow-fast and fast-slow tests, they are the stress and strain when the strain rate changed from the fast to the slow rate.

[f]The axial plastic strain was the controlled variable.

[g]Value measured from the hysteresis loop at $N_f/2$.

[h]Specimen was initially cycled at $\Delta\varepsilon = 0.97\%$ for 282 cycles using a 0.05-½-20 cpm waveform. Since this precycling was not considered damaging, the value of N_f does not include these cycles.

[i]Test was stopped and restarted. The stress and strain were measured near 5,288 cycles. The large tensile mean stress appears to be an anomaly. Specimen No. 263 was initially cycled under the same conditions as No. 257 but developed a mean compressive stress after 282 cycles.

[j]Value not recorded.

[k]Stress and strain measured at $N_f/4$.

[ℓ]No stress vs. log cycles graph.

[m]No graphs.

[n]Stresses measured only at the beginning, at 50%, and at 75% of the life.

[o]No table.

TABLE 4

AF-115 DATA

SPEC. NO.	TYPE OF TEST	A-RATIO	TOTAL[a] STRAIN -RANGE (%)	CYCLES[b] TO FAILURE	INEL. STRAIN -RANGE (%)	MAX. TENSILE STRESS (KSI)	MAX. COMPR. STRESS (KSI)	TIME[b] TO FAILURE (HOURS)	ELASTIC MODULUS (KSI*10^3)	TEMP (F)
201	20CPM	+1	.90	883	.05000	137.6	85.3	.74	24.0	1400
202	20CPM	+1	.70	2153	.02000	133.6	40.0	1.79	24.5	1400
507	20CPM	+1	.90	763+	.04500	141.6	81.9	.64+	25.9	1400
502	20CPM	+1	.90	1172	.03500	155.6	86.5	.98	26.4	1400
508	20CPM	+1	.80	2068	.03500	142.3	56.9	1.72	24.9	1400
505	20CPM	+1	.60	17257+	.01000	128.6	12.8	14.40+	24.1	1400

[a]Nominal value

[b]A "+" after the number indicates that the material within the gage length should have lasted more cycles because the specimen broke outside of the gage length.

TABLE 5

AF2-1DA DATA

SPEC. NO.	TYPE OF TEST	A-RATIO	TOTAL[a] STRAIN -RANGE (%)	CYCLES[b] TO FAILURE	INEL. STRAIN -RANGE (%)	MAX. TENSILE STRESS (KSI)	MAX. COMPR. STRESS (KSI)	TIME[b] TO FAILURE (HOURS)	ELASTIC MODULUS (KSI*10^3)	TEMP (F)
202	20CPM	+1	1.30	285	.29000	141.9	145.2	.24	25.8	1400
122	20CPM	+1	1.10	688	.13000	131.6	123.3	.57	25.2	1400
208	20CPM	+1	1.10	732	.21000	127.2	115.1	.61	26.5	1400
219	20CPM	+1	.90	1640+	.07500	127.2	99.4	1.37+	25.5	1400
207	20CPM	+1	.80	2693	.07000	122.5	75.1	2.24	26.3	1400
224	20CPM	+1	.75	3465	.03500	124.4	5[illegible].7	2.90	25.6	1400
225	20CPM	+1	.70	3385	.03500	123.7	64.0	2.82	27.4	1400
201	20CPM	+1	.70	7104+	.02000	123.3	56.4	5.92+	25.7	1400
215	20CPM	+1	.64	10448	.01600	123.3	39.7	8.70	26.1	1400
211	20CPM	+1	.64	13228+	.03400	113.3	44.9	11.00+	25.2	1400
121	20CPM	+1	.65	14823+	.02000	110.5	47.4	12.35+	24.3	1400
223	20CPM	+1	.60	15942+	.01100	114.9	43.3	13.29+	25.1	1400
221	20CPM	+1	.55	50260+	.01500	112.1	31.0	41.88+	26.7	1400
205	20CPM	+1	.50	84724	.01600	115.3	5.9	70.60	27.0	1400
231	.2 CPM	+1	1.30	358	.33000	128.0	123.7	29.80	24.8	1400
232	.2 CPM	+1	1.10	608	.32000	114.1	111.3	50.67	27.6	1400
204	.2 CPM	+1	1.10	630	.25000	119.3	115.3	52.50	26.2	1400
233	.2 CPM	+1	.90	1173	.17000	110.5	91.5	97.75	26.0	1400
210	.2 CPM	+1	.60	2346	.12000	103.4	81.5	195.50	24.7	1400
228	.2 CPM	+1	.70	3442+	.04000	98.6	60.4	286.80+	23.8	1400

[a]Nominal value.

[b]A "+" after the number indicates that the material within the gage length should have lasted more cycles because the specimen broke outside of the gage length.

SECTION 6
DISCUSSION

The stress behavior during the fatigue test was studied for two reasons. First, it was desired to determine the magnitude of the change in the stresses (and, consequently, the strains) from their value at one-half the fatigue life ($N_f/2$). Most modeling of low-cycle fatigue life is based upon the assumption of stable material behavior and makes use of the values of stress and strain at $N_f/2$ to predict the fatigue life. The assumption of stable material behavior is that cyclic hardening or softening occurs only during the initial stage of the fatigue test and thereafter the stress-strain behavior is stable for the remainder of the test. Thus, the values of stress and strain remain constant during most of the test, and $N_f/2$ becomes a convenient point at which to measure them. Since a question arose as to the validity of this assumption for René 95, the behavior of the stresses was examined.

The second purpose was to determine whether the stress behavior followed a simple pattern. It was known that the tensile-hold tests had compressive mean stresses, while the opposite was true for the compressive-hold tests. It was felt that these mean stresses significantly influenced the fatigue life (Ref. 4). Thus, if a simple relationship could be established between the strain-time waveform and the resulting stresses, then one would be better able to predict the fatigue life.

There was not sufficient time to permit a thorough analysis of the data; therefore, only data trends and observations are reported. These observations concern the René 95 data only. No explanation for them is offered.

René 95 initially strain hardens, maintains a maximum hardness for a short period, and then begins to soften. The softening continues throughout the life of the test specimen. This behavior is shown most clearly in Fig. 3 for Test No. 240, a 20-cpm test at a total strain range of 1.6%. Strain hardening is completed in about ten cycles; this maximum hardness is retained

for about another sixty to seventy cycles until strain-softening sets in. Then the material continually softens until failure at 463 cycles.

The most noticeable aspect of the tensile-only strain-hold tests is the large and rapid shift in the mean stress--especially for tests at the lower strainranges and longer hold times. Figure 4 shows Test No. 233--a 1/0 test at a strainrange of 1.0%--in which the mean stress changed from about zero to -25 ksi during the first 10% of the life. The mean stress continued to shift in the compressive direction throughout the remainder of the test. Shifts to a tensile mean stress occurred for the compression-only strain-hold tests but were less dramatic. Continual shifts in the mean stress also occurred for those tests run at an A-ratio other than infinity.

Although the stresses were continually changing in the tension-only and compression-only strain-hold tests, the amount of stress relaxed during the hold period remained relatively constant throughout the test. That is, the amount of stress relaxed was a function not only of the stress at the beginning of the hold period but also of the history of the cycle--such as the previous maximum or minimum stress. However, for those tests involving both a tensile and compressive hold period, the amount of stress relaxed increased throughout the test.

When the stresses were plotted as a function of the logarithm of the number of cycles, the softening and stress shifts described above followed--to a first approximation--a log-linear pattern. However, the initial hardening and area of maximum hardness did not follow such a pattern.

As can be seen from the plots of stress vs logarithm of the cycles (log N), the material does not exhibit a stable cyclic stress-strain behavior. It is continually softening until fracture. When examined on a linear scale, the softening is not so apparent and it may appear to have an asymptotic value. However, when viewed on a logarithmic scale, the softening is seen to be a continuing process.

Since the material continually softens, methods that determine an initiation life from load drop must be used with caution. Most of these methods consider initiation to have taken place when the tensile stress or the stress-range has decreased by 5 or 10% from the initial or maximum value. For a material which continuously softens, such as René 95, these methods could yield erroneous results. A modification to the method can be made for softening materials by taking a 5 or 10% load drop-off from the softening line instead of from the initial or maximum value. The softening line must first be determined by plotting the stress as a function of log N and drawing a line through the data. When the tensile stress falls by 5 or 10% below the stress predicted by this line, then initiation can be considered to have taken place. An example of this method is Test No. 233, in Fig. 5, where the almost vertical drop in the stress indicates where initiation has taken place.

Unequivocal answers as to the purposes for which the study was undertaken cannot be given. The assumption of stable material behavior for René 95 is not valid. However, the degree to which the assumption is satisfied varies with test conditions. For tests at higher strainranges, there is little variation in the stresses from $N_f/2$; however, the variation at lower strainranges is greater. The use of the stresses and strains at $N_f/2$ to model fatigue behavior is problematic. It cannot be strictly justified on the grounds of stable material behavior, but the variation of the stresses from the values at $N_f/2$ may not have that much influence upon fatigue modeling. Also, using the values at $N_f/2$ may be justified because they can be considered characteristic of the particular test condition--i.e., each test condition results in a unique value of stress and strain at $N_f/2$. In addition, there are no other accepted methods of modeling fatigue life except through the use of the values at $N_f/2$.

No simple relationship was found which adequately models the stress behavior during the test. To a first approximation, the stress behavior could be considered to follow a log-linear pattern. However, deviations from this

pattern are apparent in the data during the initial part of the test. Also, the data show deviation from a log-linear pattern during the latter portions of the test.

A final comment concerns the effect of plotting stress as a function of N on a log-log plot. Plots of this type were made in order to determine whether the logarithm of stress yields a more linear relationship with log N than stress itself. Figures 6 and 7 are examples of these types of plots. Taking the logarithm of stress did not produce such a relationship, and no marked contrast between a semi-log and log-log plot was observed.

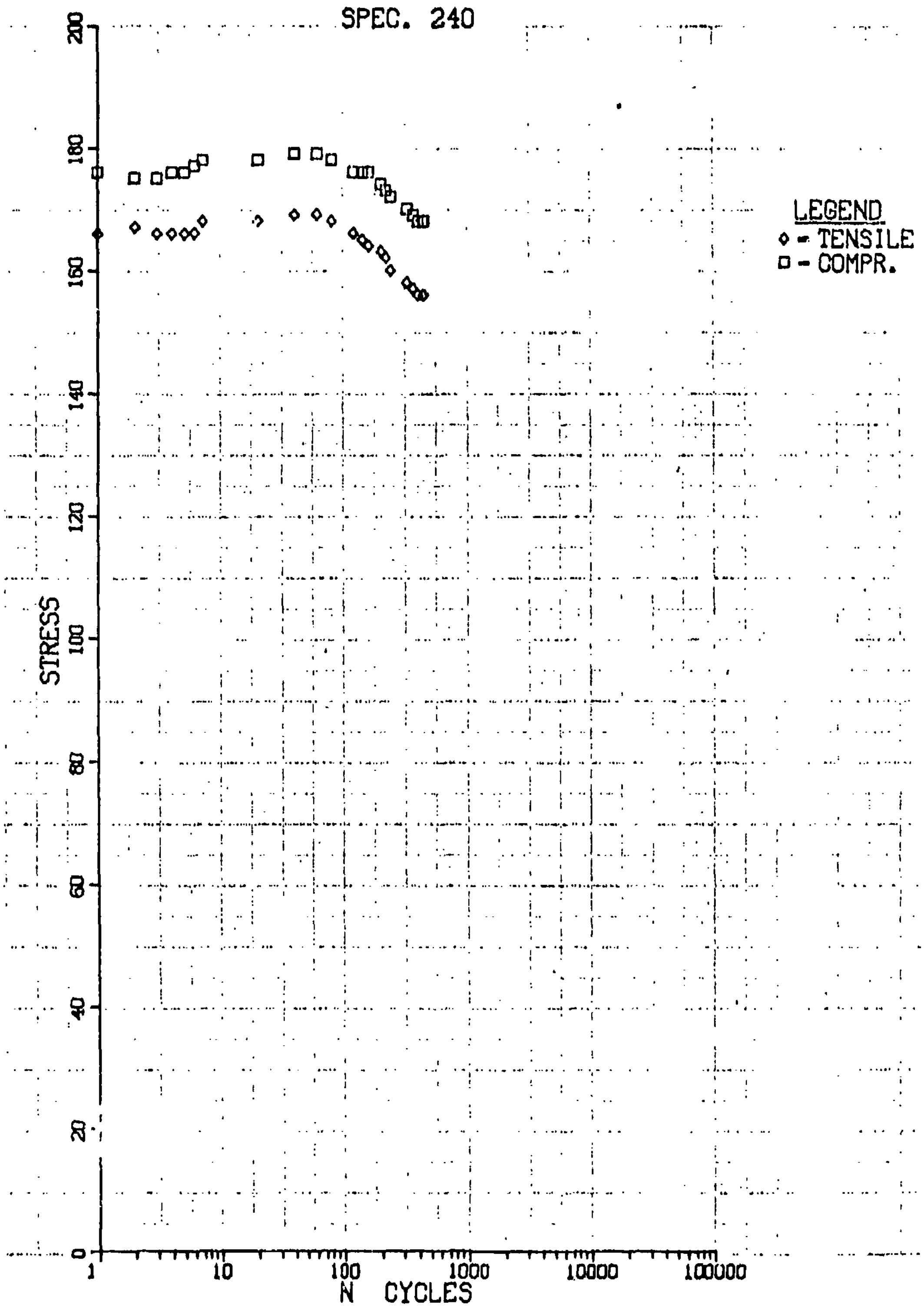


Figure 3. Hardening and Softening of a 20-cpm Test.

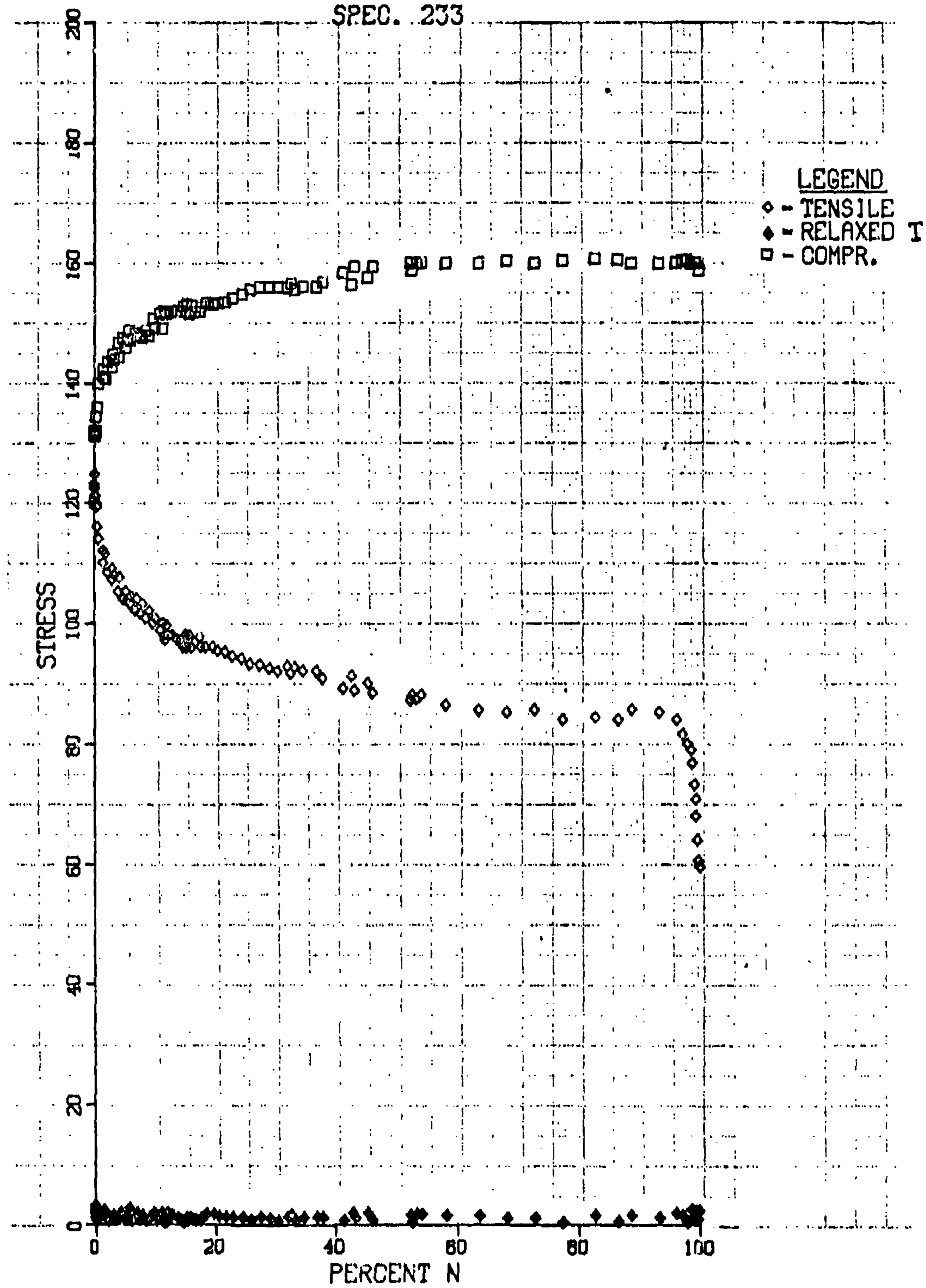


Figure 4. Mean Stress Behavior in a Tensile-Only Strain-Hold Test.

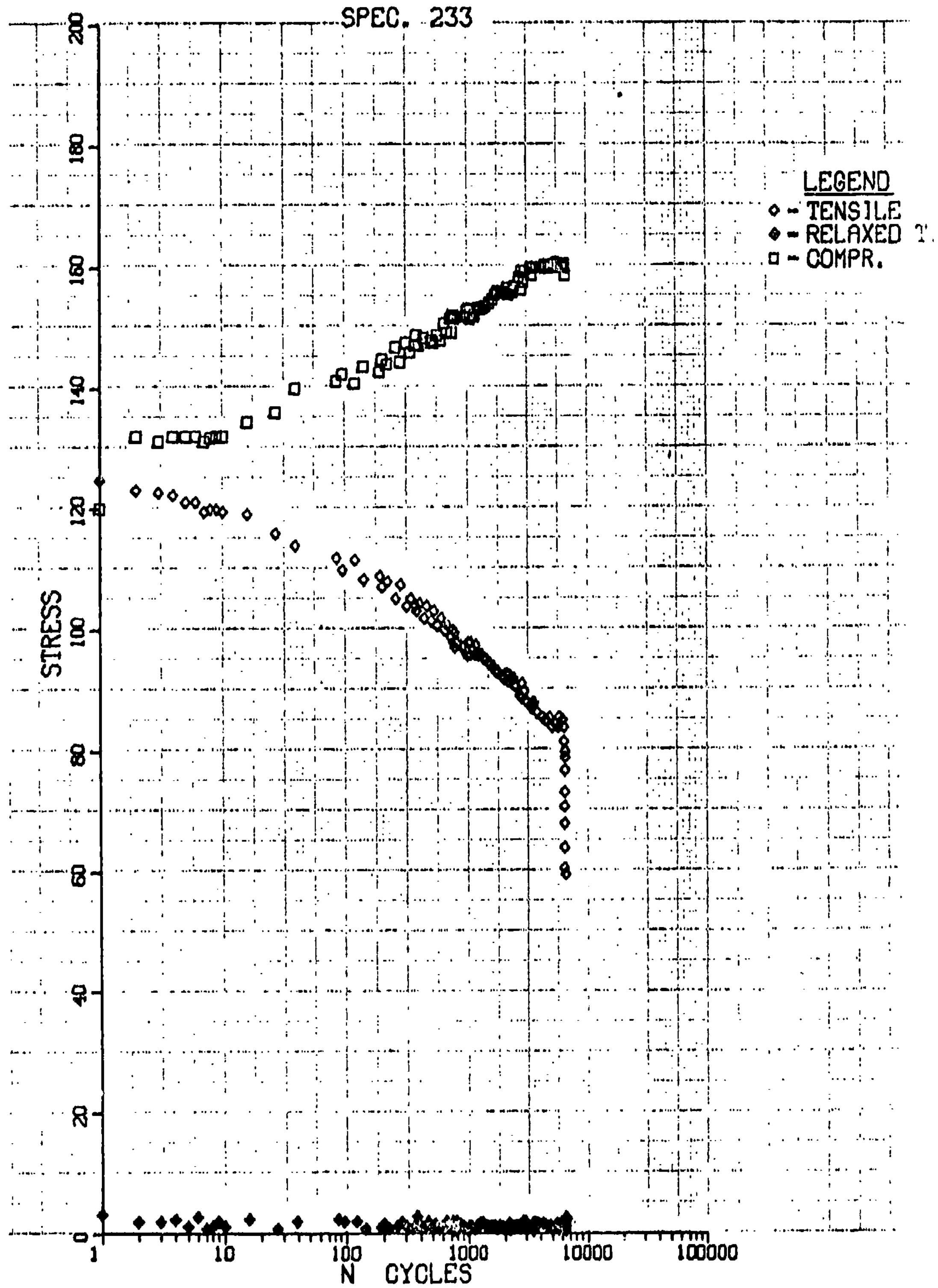


Figure 5. Stress vs. Number of Cycles for Specimen 233.

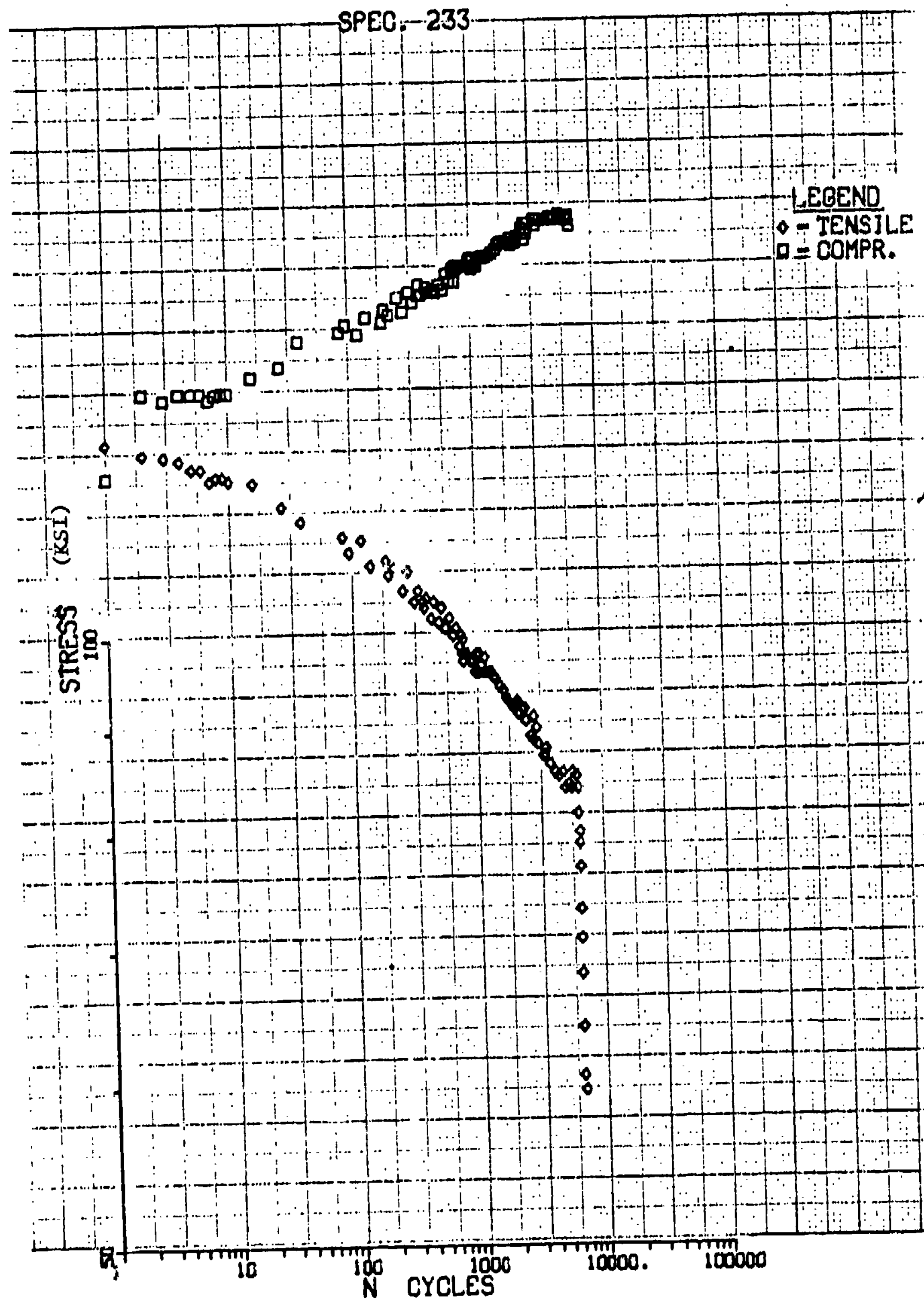


Figure 6. Stress vs. Number of Cycles on a Log-Log Scale for Specimen 233.

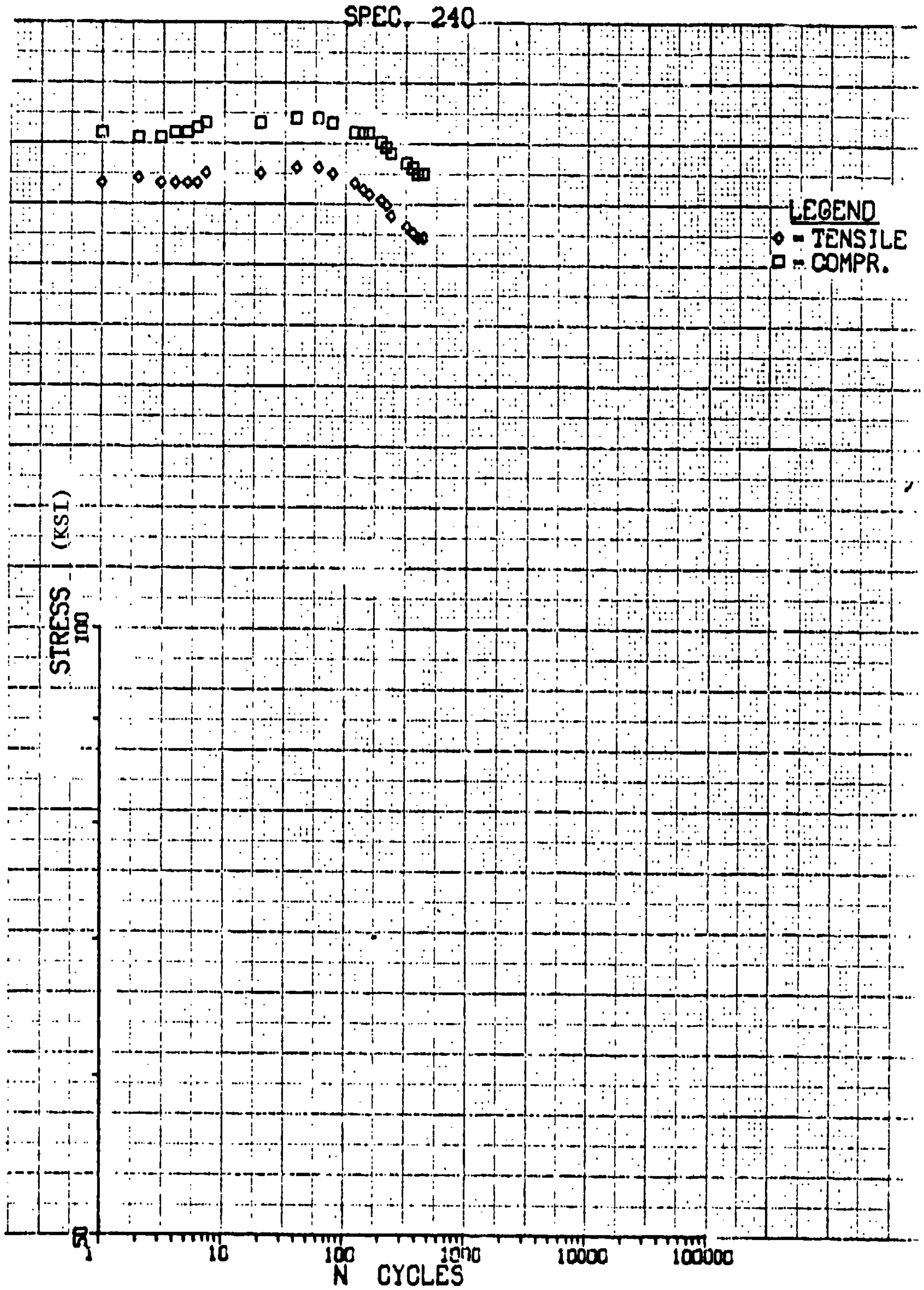


Figure 7. Stress vs. Number of Cycles on a Log-Log Scale for Specimen 240.

SECTION 7

RENE 95 CONTINUOUS CYCLING TESTS

Data from the continuous cycling tests on René 95 are presented in this section. These tests are composed of the 20-cpm tests at A-ratios of infinity, plus one, minus one and plus one-fifth, and the 0.05 cpm tests. These data are presented in Tables 6 through 17 and Figures 8 through 23.

TABLE 6

						SPECIMEN 17
			STRESSES			
I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
1	0.	0.00	22.	0.0	7.	0.0
2	2.	.85	53.	0.0	40.	0.0
3	14.	5.98	175.	0.0	186.	0.0
4	56.[a]	23.93	180.	0.0	193.	0.0
5	82.	35.04	180.	0.0	196.	0.0
6	105.	44.87	179.	0.0	195.	0.0
7	140.	59.83	176.	0.0	193.	0.0
8	164.	70.09	174.	0.0	191.	0.0
9	187.	79.91	172.	0.0	190.	0.0
10	208.	88.89	171.	0.0	189.	0.0
11	220.	94.02	170.	0.0		0.0
12	232.	99.15	168.	0.0		0.0
13	234.	100.00	148.	0.0	188.	0.0

[a]Full load reached at about 30 cycles.

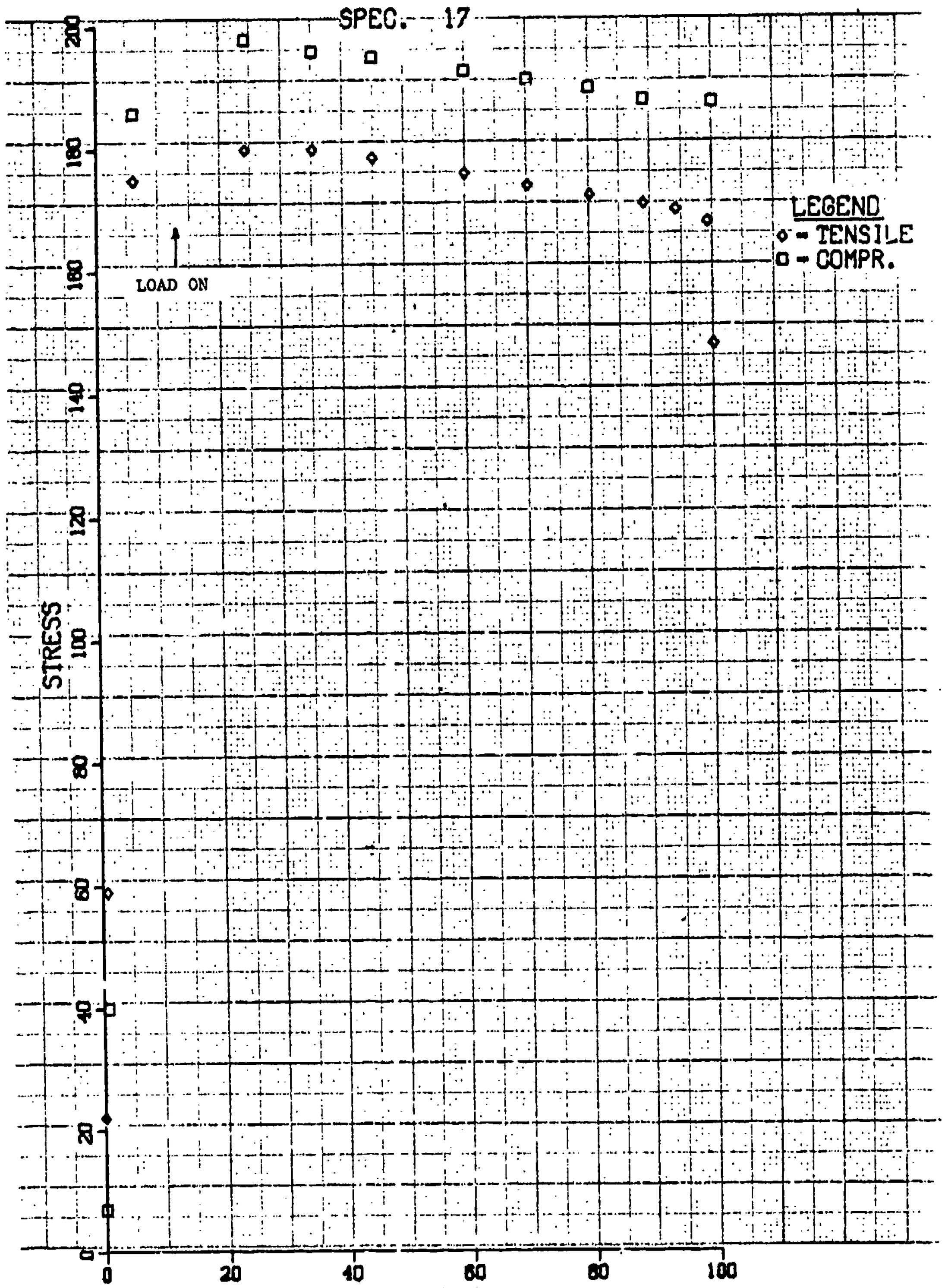

SPEC. 17
STRESS
0
20
40
60
80
100
120
140
160
180
200
LOAD ON
LEGEND
◇ - TENSILE
□ - COMPR.
PERCENT N

Figure 8.

TABLE 7

SPECIMEN 16

			---------	STRESSES	--------	
I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
1	0.	0.00	7.	0.0	12.	0.0
2	4.	1.30	46.	0.0		0.0
3	7.	2.28	46.	0.0	46.	0.0
4	12.	3.91	96.	0.0		0.0
5	13.	4.23	108.	0.0	116.	0.0
6	18.	5.86	150.	0.0	160.	0.0
7	21.	6.84	164.	0.0		0.0
8	30.	9.77	175.	0.0	184.	0.0
9	39.[a]	12.70	178.	0.0	186.	0.0
10	59.	19.22	178.	0.0	188.	0.0
11	79.	25.73	178.	0.0	189.	0.0
12	98.	31.92	178.	0.0	188.	0.0
13	116.	37.79		0.0	188.	0.0
14	120.	39.09		0.0	188.	0.0
15	122.	39.74	179.	0.0		0.0
16	131.	42.67	177.	0.0		0.0
17	138.	44.95		0.0	187.	0.0
18	144.	46.91	176.	0.0		0.0
19	147.	47.88		0.0	187.	0.0
20	152.	49.51	176.	0.0		0.0
21	159.	51.79	175.	0.0		0.0
22	180.	58.63	174.	0.0	184.	0.0
23	199.	64.82	173.	0.0	184.	0.0
24	238.	77.52	171.	0.0	182.	0.0
25	277.	90.23	168.	0.0	180.	0.0
26	307.	100.00	167.	0.0	180.	0.0

[a]Load on

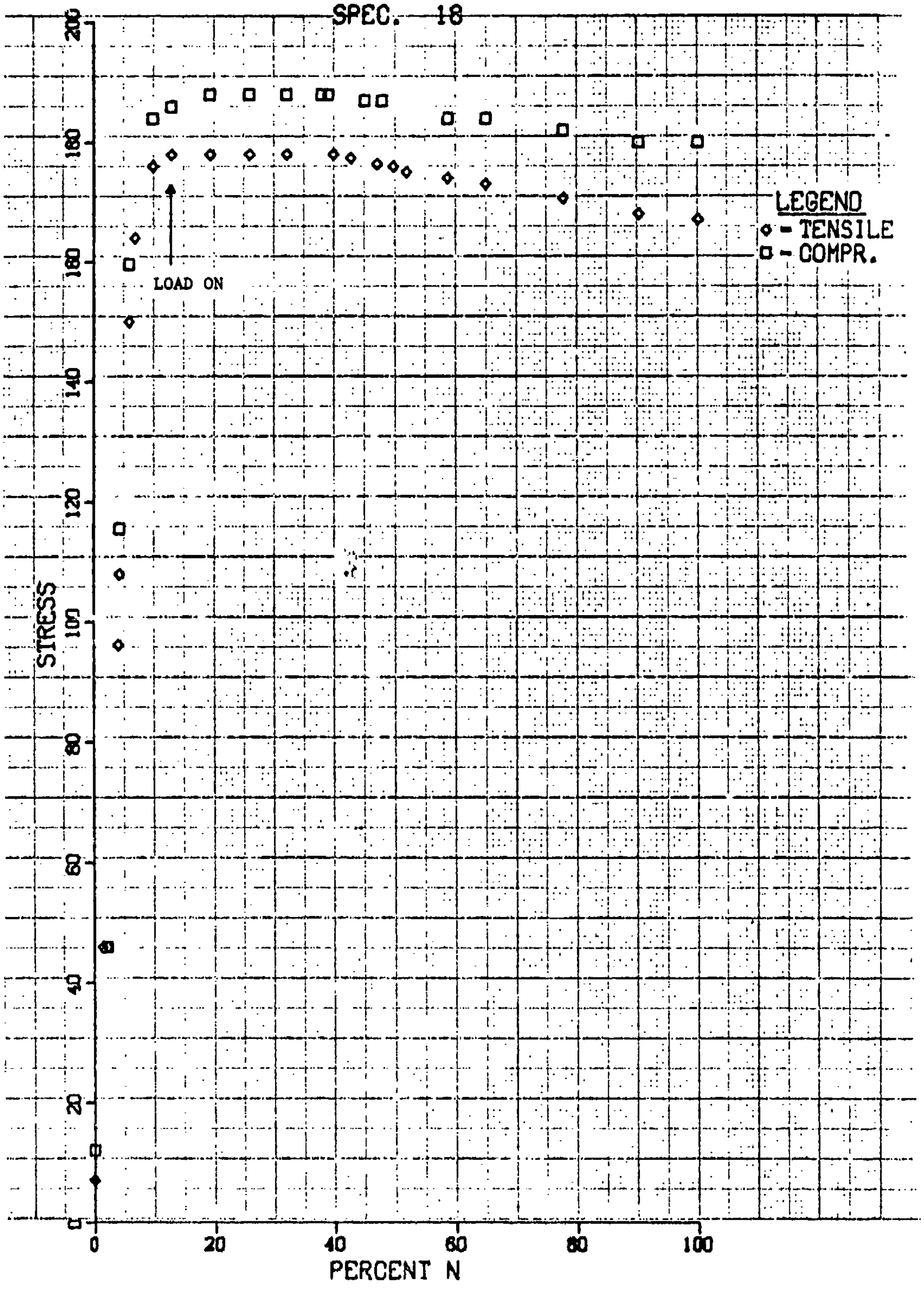

SPEC. 18
STRESS
PERCENT N
LOAD ON
LEGEND
◇ - TENSILE
□ - COMPR.
0
20
40
60
80
100
120
140
160
180
200

Figure 9.

TABLE 8

SPECIMEN 22

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			--------STRESSES-------			
1	0.	0.00	35.	0.0	12.	0.0
2	9.	1.95	131.	0.0	133.	0.0
3	23.[a]	4.99	175.	0.0	183.	0.0
4	41.	8.89	176.	0.0	183.	0.0
5	65.	14.10	175.	0.0	184.	0.0
6	115.	24.95	173.	0.0	181.	0.0
7	157.	34.06	171.	0.0	178.	0.0
8	230.	49.89	168.	0.0	172.	0.0
9	295.	63.99	166.	0.0	172.	0.0
10	355.	77.01	163.	0.0	170.	0.0
11	415.	90.02	161.	0.0	169.	0.0
12	456.	98.92	158.	0.0	169.	0.0
13	461.	100.00	145.	0.0	171.	0.0

[a]Load on

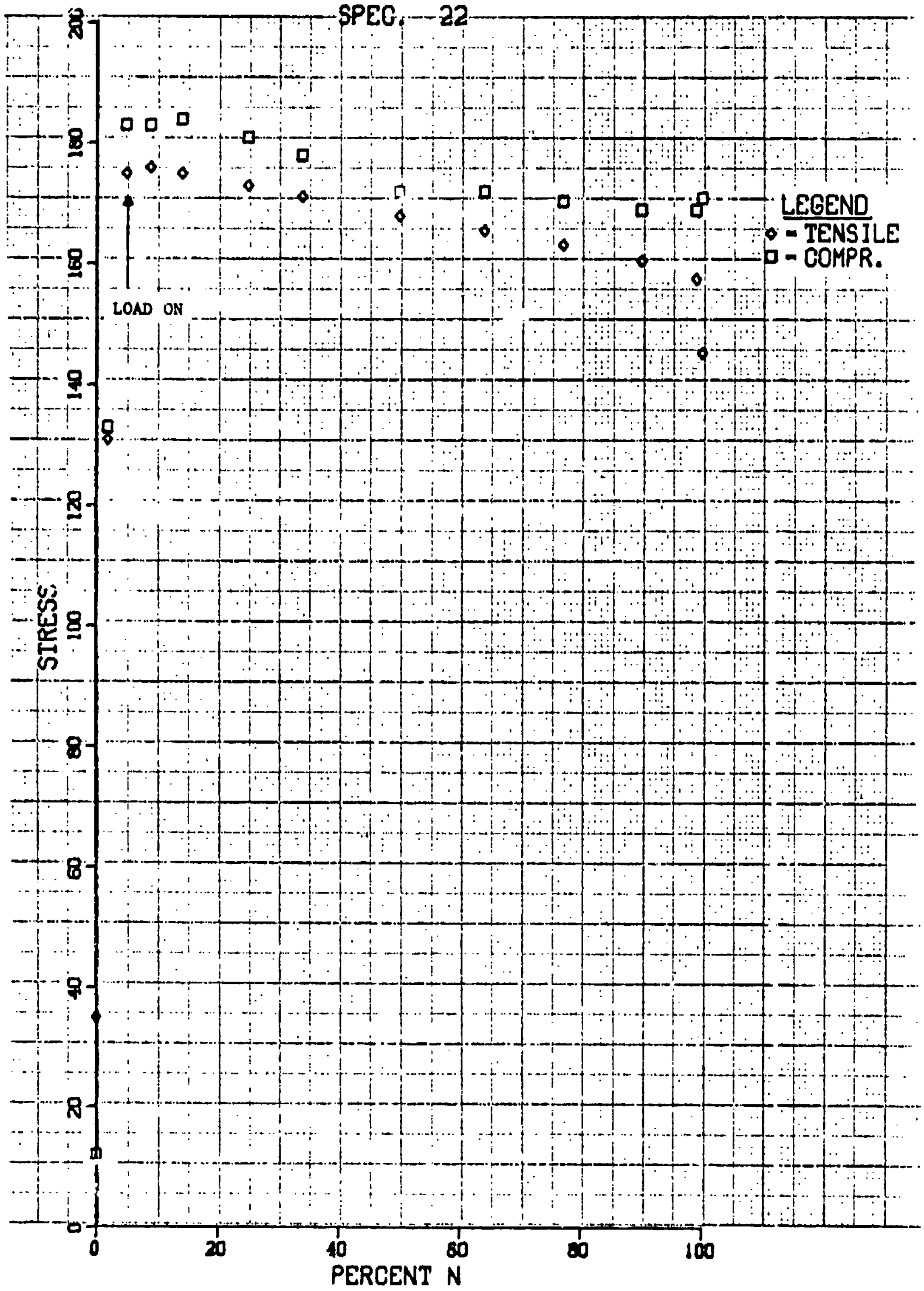

SPEC. 22
STRESS
PERCENT N
LOAD ON
LEGEND
◇ - TENSILE
□ - COMPR.
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100

Figure 10.

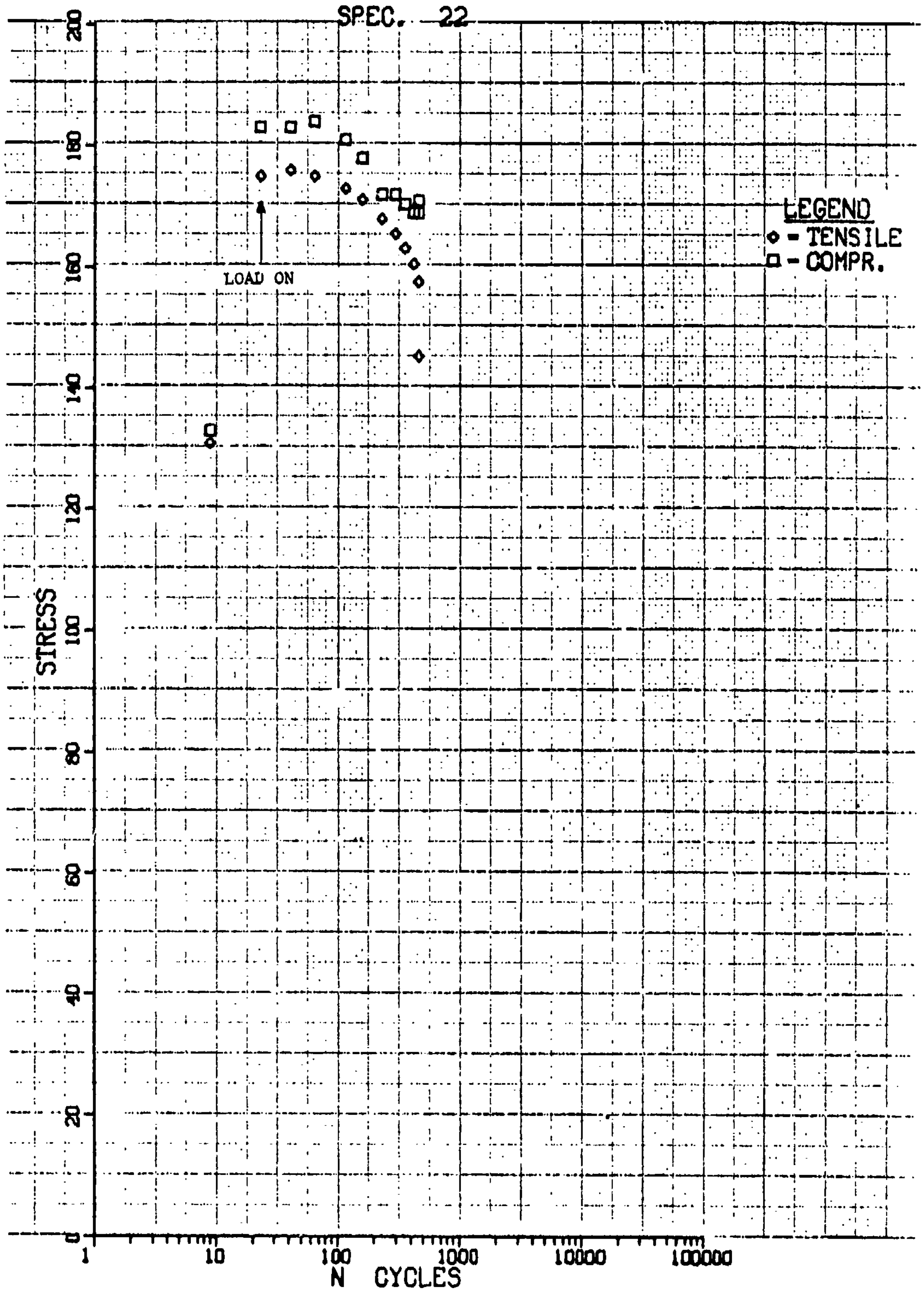

SPEC. 22
STRESS
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
100000
N CYCLES
LOAD ON
LEGEND
◇ - TENSILE
□ - COMPR.

Figure 11.

TABLE 9

SPECIMEN 240

			---------STRESSES-------			
I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
1	1.	.22	166.	0.0	176.	0.0
2	2.	.43	167.	0.0	175.	0.0
3	3.	.65	166.	0.0	175.	0.0
4	4.	.86	166.	0.0	176.	0.0
5	5.	1.08	166.	0.0	176.	0.0
6	6.	1.30	166.	0.0	177.	0.0
7	7.	1.51	168.	0.0	178.	0.0
8	20.	4.32	168.	0.0	178.	0.0
9	40.	8.64	169.	0.0	179.	0.0
10	60.	12.96	169.	0.0	179.	0.0
11	80.	17.28	168.	0.0	178.	0.0
12	120.	25.92	166.	0.0	176.	0.0
13	140.	30.24	165.	0.0	176.	0.0
14	160.	34.56	164.	0.0	176.	0.0
15	200.	43.20	163.	0.0	174.	0.0
16	220.	47.52	162.	0.0	173.	0.0
17	240.	51.84	160.	0.0	172.	0.0
18	320.	69.11	158.	0.0	170.	0.0
19	360.	77.75	157.	0.0	169.	0.0
20	400.	86.39	156.	0.0	168.	0.0
21	440.	95.03	156.	0.0	168.	0.0
22	450.	97.19	156.	0.0	168.	0.0

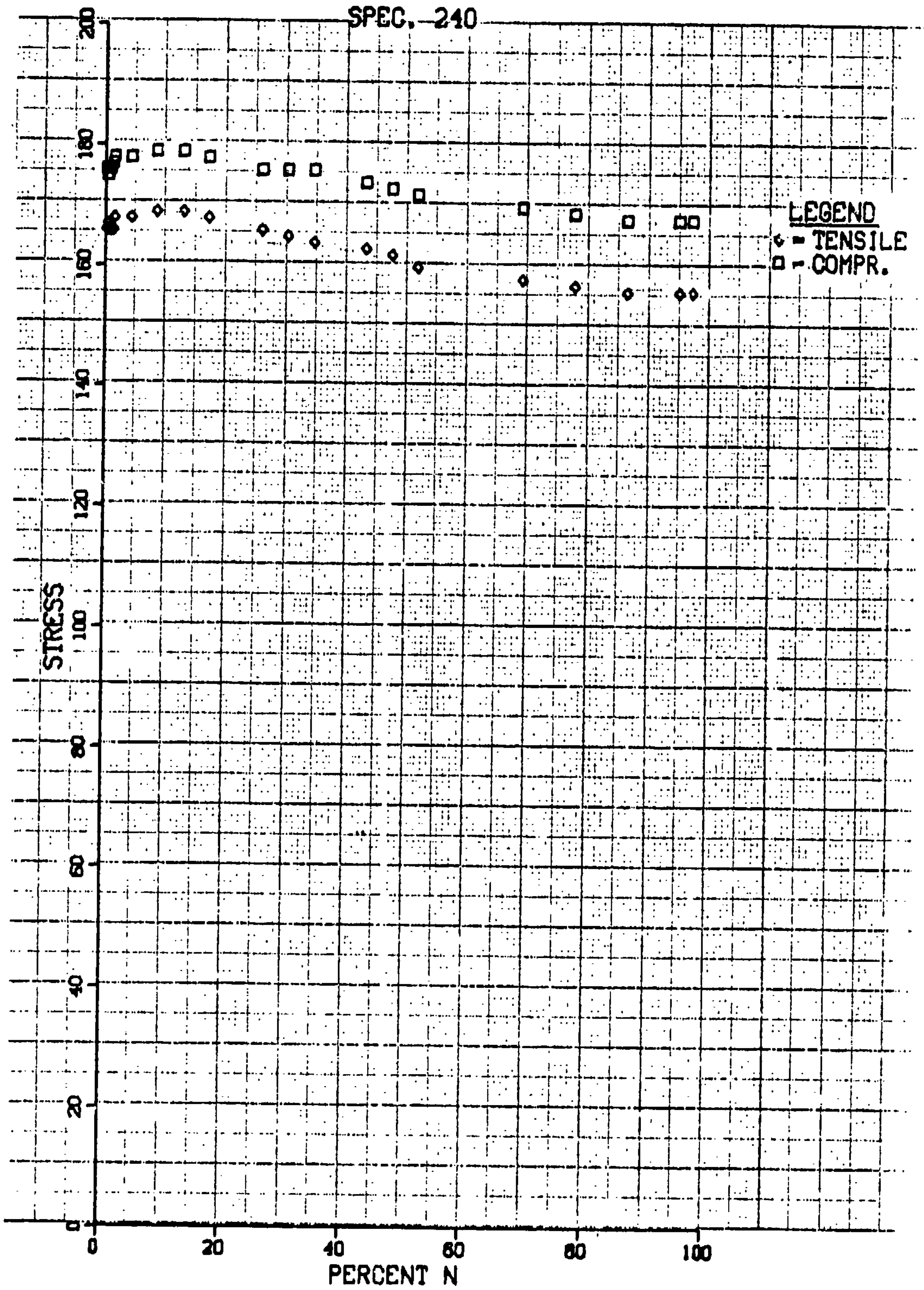
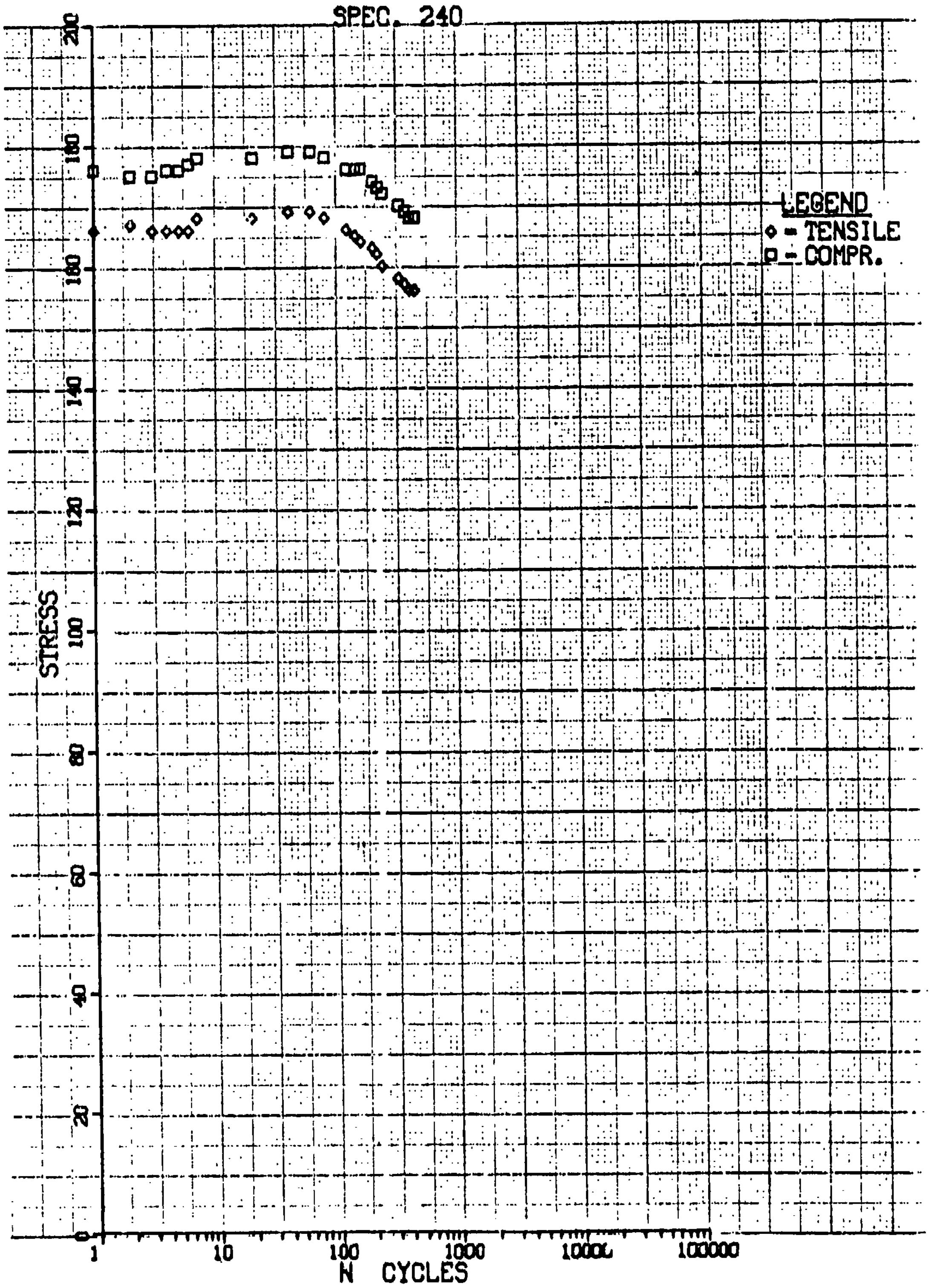

SPEC. 240
LEGEND
◇ = TENSILE
□ = COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
PERCENT N

Figure 12.



SPEC. 240
STRESS
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
100000
N CYCLES
LEGEND
◇ - TENSILE
□ - COMPR.

Figure 13.

TABLE 10

SPECIMEN 27

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			--------STRESSES	-------		
1	0.	0.00	147.	0.0	150.	0.0
2	2.	.12	145.	0.0	151.	0.0
3	33.	2.03	146.	0.0	151.	0.0
4	33.	2.03	147.	0.0	150.	0.0
5	81.	4.97	145.	0.0	151.	0.0
6	163.	10.01	145.	0.0	150.	0.0
7	326.	20.01	143.	0.0	149.	0.0
8	244.	14.98	144.	0.0	149.	0.0
9	358.	21.98	142.	0.0	149.	0.0
10	358.	21.98	142.	0.0	149.	0.0
11	489.	30.02	141.	0.0	147.	0.0
12	603.	37.02	140.	0.0	147.	0.0
13	684.	41.99	140.	0.0	147.	0.0
14	766.	47.02	140.	0.0	146.	0.0
15	798.	48.99	140.	0.0	147.	0.0
16	847.	52.00	139.	0.0	147.	0.0
17	880.	54.02	139.	0.0	146.	0.0
18	929.	57.03	140.	0.0	146.	0.0
19	961.	58.99	138.	0.0	145.	0.0
20	994.	61.02	133.	0.0	146.	0.0
21	1043.	64.03	135.	0.0	146.	0.0
22	1124.	69.00	138.	0.0	146.	0.0
23	1157.	71.03	136.	0.0	146.	0.0
24	1205.	73.97	137.	0.0	145.	0.0
25	1287.	79.01	137.	0.0	146.	0.0
26	1368.	83.98	137.	0.0	145.	0.0
27	1368.	83.98	136.	0.0	145.	0.0
28	1401.	86.00	135.	0.0	144.	0.0
29	1434.	88.03	136.	0.0	146.	0.0
30	1482.	90.98	135.	0.0	145.	0.0
31	1564.	96.01	133.	0.0	146.	0.0
32	1596.	97.97	129.	0.0	147.	0.0
33	1629.	100.00	124.	0.0	149.	0.0

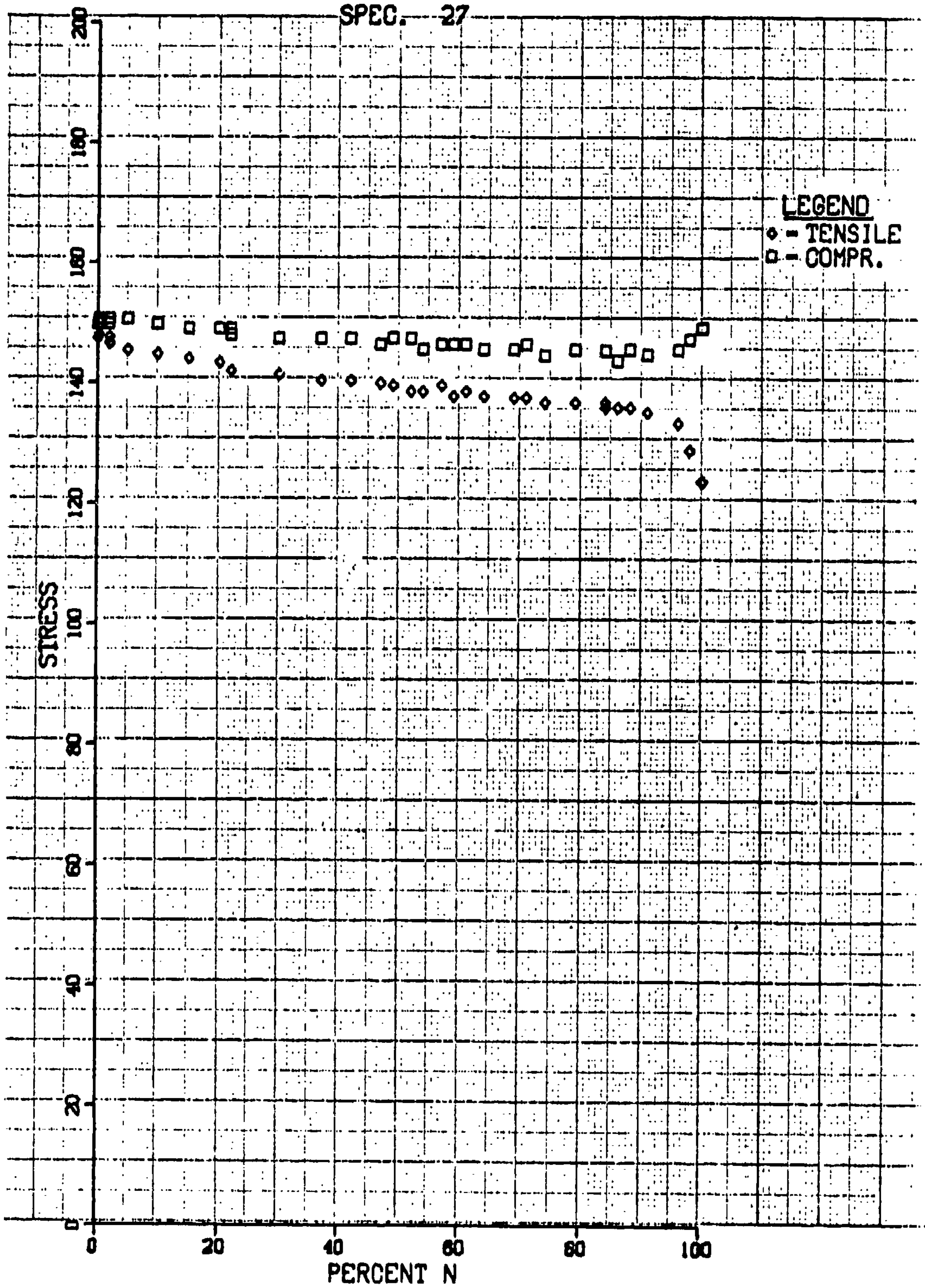

SPEC. 27
LEGEND
◇ - TENSILE
□ - COMPR.
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 14.

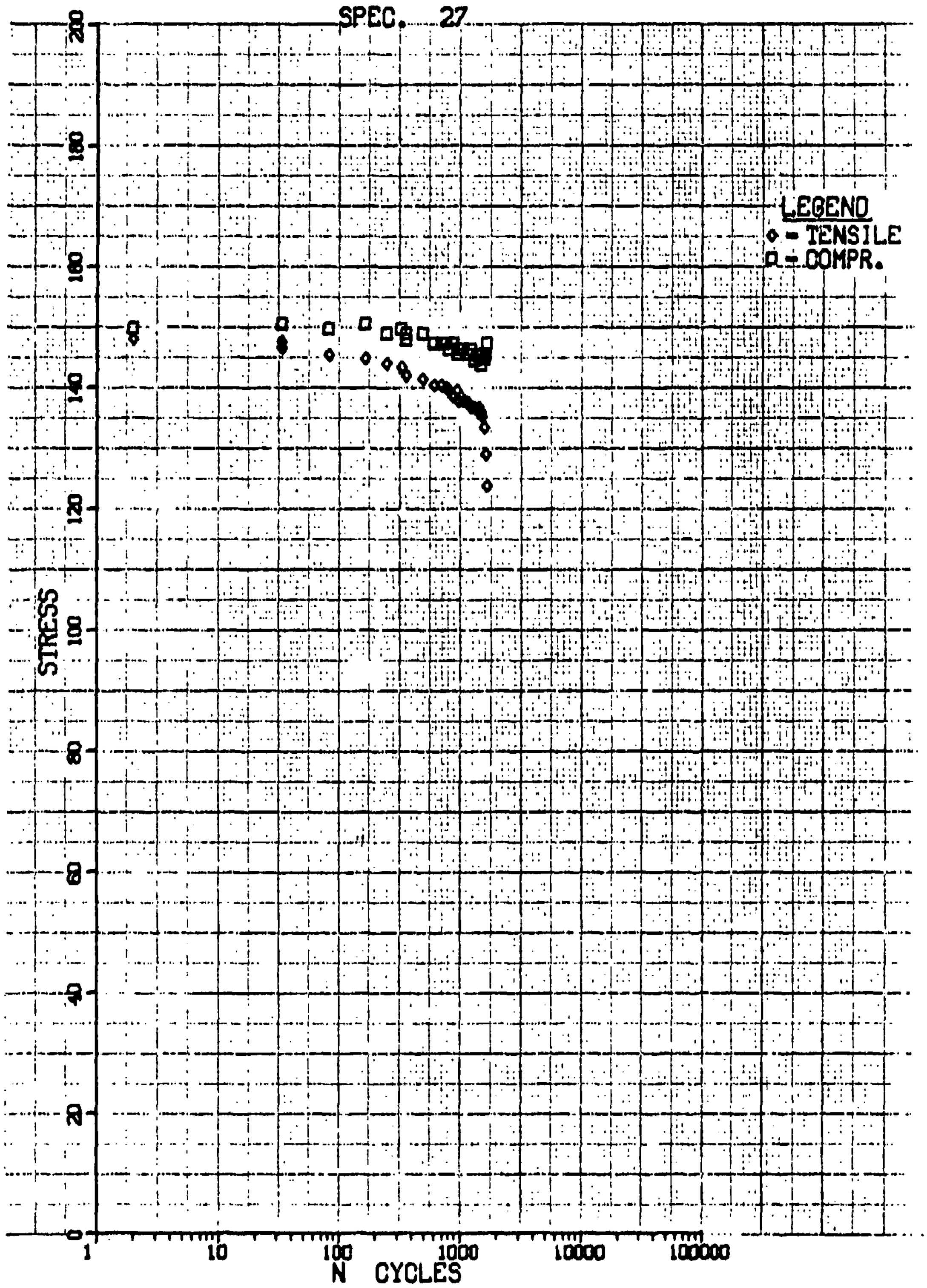

SPEC. 27
LEGEND
◇ = TENSILE
□ = COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 15.

TABLE 11

SPECIMEN 234

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	.01	2.	0.0	13.	0.0
2	2.	.01	22.	0.0	32.	0.0
3	3.	.02	36.	0.0	49.	0.0
4	4.	.02	53.	0.0	64.	0.0
5	5.	.03	67.	0.0	72.	0.0
6	6.	.03	73.	0.0	78.	0.0
7	7.	.04	77.	0.0	88.	0.0
8	8.	.04	81.	0.0	92.	0.0
9	9.	.05	89.	0.0	100.	0.0
10	10.	.05	96.	0.0	106.	0.0
11	11.	.06	102.	0.0	110.	0.0
12	12.	.06	104.	0.0	114.	0.0
13	13.	.07	107.	0.0	117.	0.0
14	14.[a]	.07	111.	0.0	120.	0.0
15	15.	.08	112.	0.0	120.	0.0
16	16.	.08	112.	0.0	120.	0.0
17	17.	.09	112.	0.0	120.	0.0
18	18.	.09	112.	0.0	120.	0.0
19	19.	.10	113.	0.0	120.	0.0
20	20.	.10	113.	0.0	120.	0.0
21	9580.	50.00	99.	0.0	135.	0.0
22	14370.	75.00	99.	0.0	135.	0.0

[a]Load on

TABLE 12

SPECIMEN 235

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			STRESSES			
1	1.	.00	4.	0.0	12.	0.0
2	2.	.01	16.	0.0	24.	0.0
3	3.	.01	28.	0.0	36.	0.0
4	4.	.02	42.	0.0	54.	0.0
5	5.	.02	58.	0.0	69.	0.0
6	6.	.03	70.	0.0	76.	0.0
7	9.	.04	86.	0.0	104.	0.0
8	10.	.04	96.	0.0	109.	0.0
9	11.	.05	100.	0.0	112.	0.0
10	12.	.05	106.	0.0	116.	0.0
11	13.	.06	108.	0.0	117.	0.0
12	14.[a]	.06	110.	0.0	117.	0.0
13	19.	.08	112.	0.0	117.	0.0
14	11182.	50.00	100.	0.0	130.	0.0
15	16773.	75.00	100.	0.0	130.	0.0

[a]Load on

TABLE 13

SPECIMEN 264

			STRESSES			
I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
1	1.	.13	****	0.0	78.	0.0
2	2.	.27	191.	0.0	81.	0.0
3	3.	.40	192.	0.0	83.	0.0
4	4.	.53	189.	0.0	86.	0.0
5	5.	.66	189.	0.0	88.	0.0
6	20.	2.66	190.	0.0	94.	0.0
7	40.	5.32	190.	0.0	96.	0.0
8	176.	23.40	187.	0.0	100.	0.0
9	315.	41.89	185.	0.0	101.	0.0
10	400.	53.19	184.	0.0	102.	0.0
11	500.	66.49	182.	0.0	104.	0.0
12	735.	97.74	175.	0.0	108.	0.0

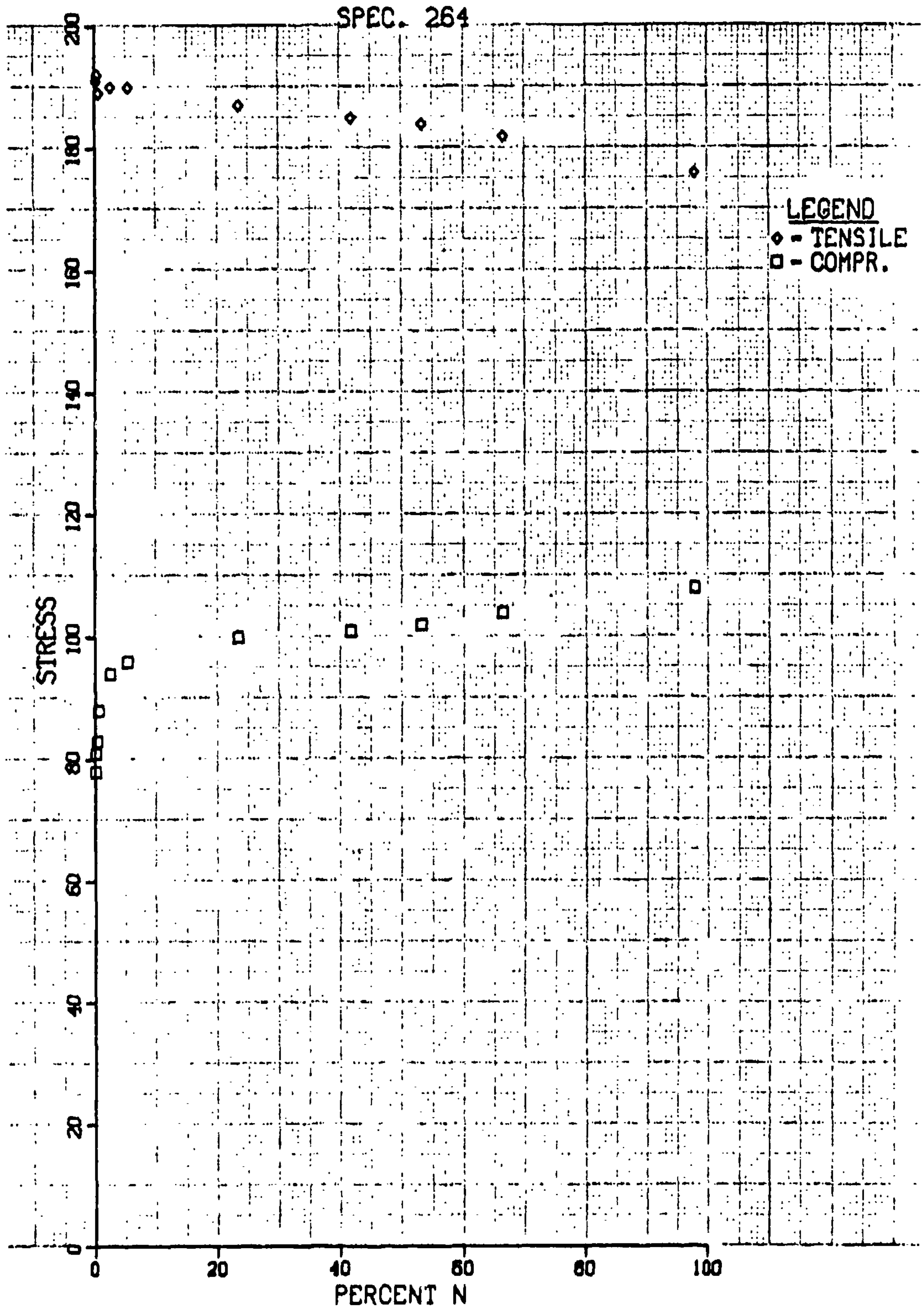

SPEC. 264
LEGEND
◇ - TENSILE
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
PERCENT N

Figure 16.

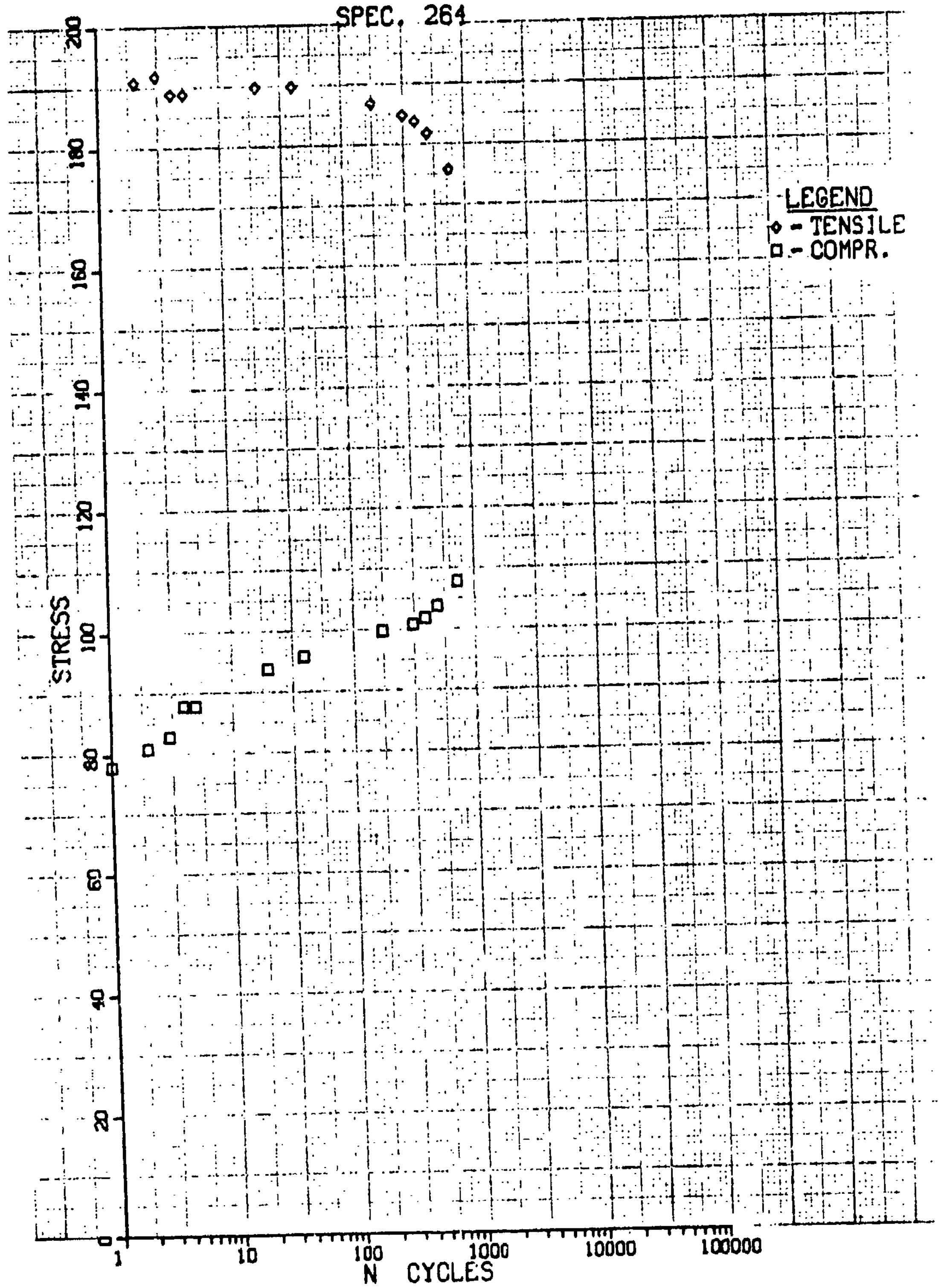

SPEC. 264
LEGEND
◇ - TENSILE
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 17.

TABLE 14

SPECIMEN 36

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	4.	.33	124.	0.0	-4.	0.0
2	9.	.75	163.	0.0	28.	0.0
3	12.	.99	155.	0.0	33.	0.0
4	15.	1.24	166.	0.0	52.	0.0
5	23.	1.91	169.	0.0	93.	0.0
6	28.	2.32	165.	0.0	100.	0.0
7	32.	2.65	168.	0.0	111.	0.0
8	37.[a]	3.07	172.	0.0	120.	0.0
9	42.	3.48	173.	0.0	124.	0.0
10	59.	4.89	171.	0.0	127.	0.0
11	81.	6.71	169.	0.0	128.	0.0
12	85.	7.04	169.	0.0	128.	0.0
13	194.	16.07	167.	0.0	130.	0.0
14	314.	26.01	165.	0.0	130.	0.0
15	474.	39.27	163.	0.0	130.	0.0
16	593.	49.13	161.	0.0	130.	0.0
17	793.	65.70	160.	0.0	129.	0.0
18	895.	74.15	158.	0.0	130.	0.0
19	1113.	92.21	155.	0.0	130.	0.0
20	1193.	98.84	152.	0.0	132.	0.0
21	1233.	100.00	143.	0.0	140.	0.0

[a] Load on

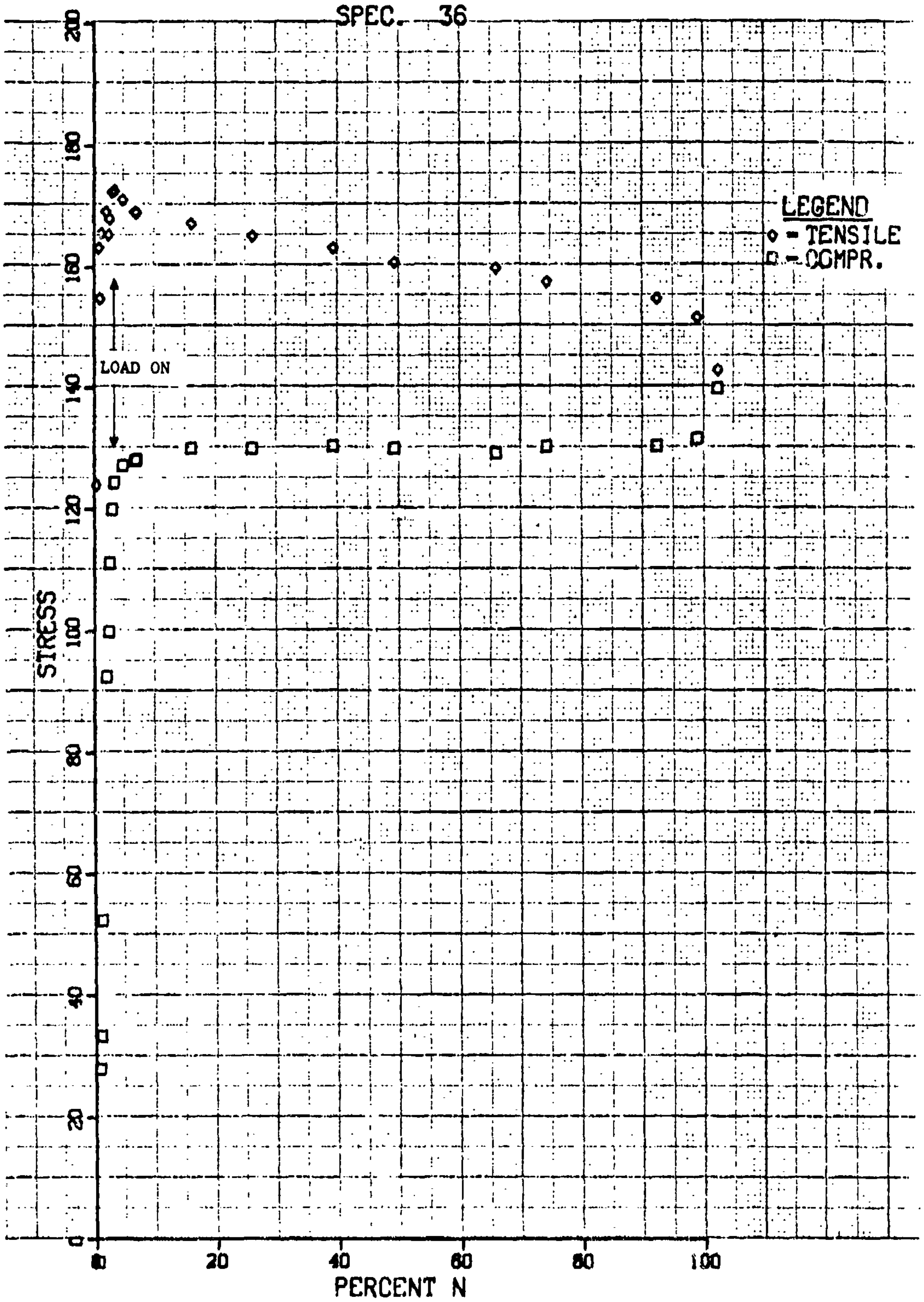

SPEC. 36
LEGEND
◇ = TENSILE
□ = COMPR.
LOAD ON
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 18.

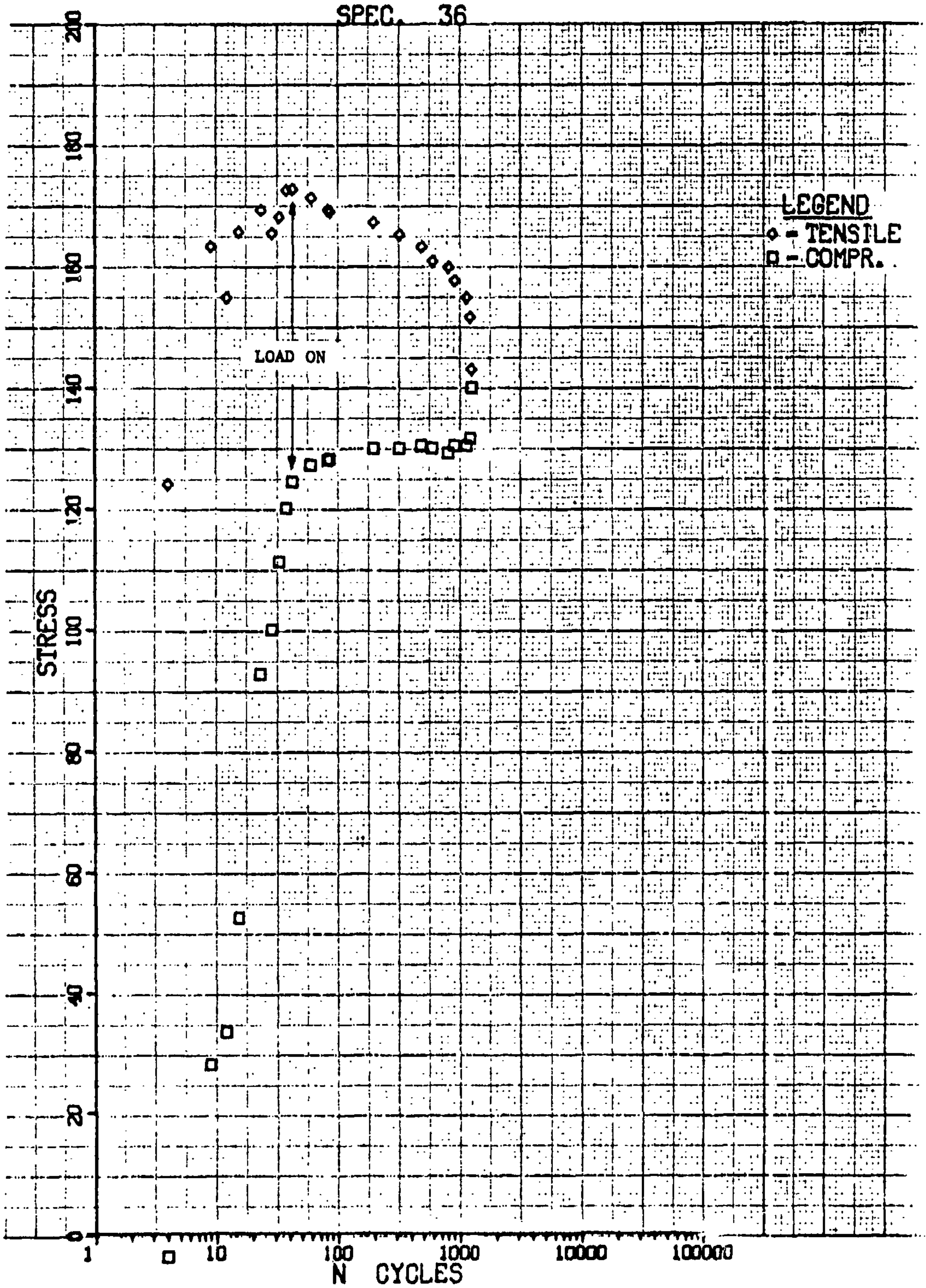

SPEC. 36
LEGEND
◇ - TENSILE
□ - COMPR.
LOAD ON
STRESS
N CYCLES
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000

Figure 19.

TABLE 15

SPECIMEN 37

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			---------STRESSES-------			
1	3.	.14	-1.	0.0	70.	0.0
2	5.	.24	-1.	0.0	107.	0.0
3	8.	.38	0.	0.0	137.	0.0
4	10.	.47	12.	0.0	160.	0.0
5	16.	.75	76.	0.0	176.	0.0
6	28.	1.32	105.	0.0	180.	0.0
7	39.[a]	1.83	112.	0.0	180.	0.0
8	54.	2.54	113.	0.0	177.	0.0
9	82.	3.86	114.	0.0	176.	0.0
10	97.	4.56	116.	0.0	176.	0.0
11	124.	5.83	114.	0.0	176.	0.0
12	342.	16.09	116.	0.0	174.	0.0
13	499.	23.47	117.	0.0	172.	0.0
14	700.	32.93	115.	0.0	172.	0.0
15	938.	44.12	115.	0.0	170.	0.0
16	1100.	51.74	116.	0.0	168.	0.0
17	1417.	66.65	114.	0.0	168.	0.0
18	1777.	83.58	112.	0.0	166.	0.0
19	1858.	87.39	110.	0.0	165.	0.0
20	1938.	91.16	105.	0.0	164.	0.0
21	1978.	93.04	102.	0.0	166.	0.0
22	2018.	94.92	96.	0.0	165.	0.0
23	2059.	96.85	84.	0.0	165.	0.0

[a]Load on

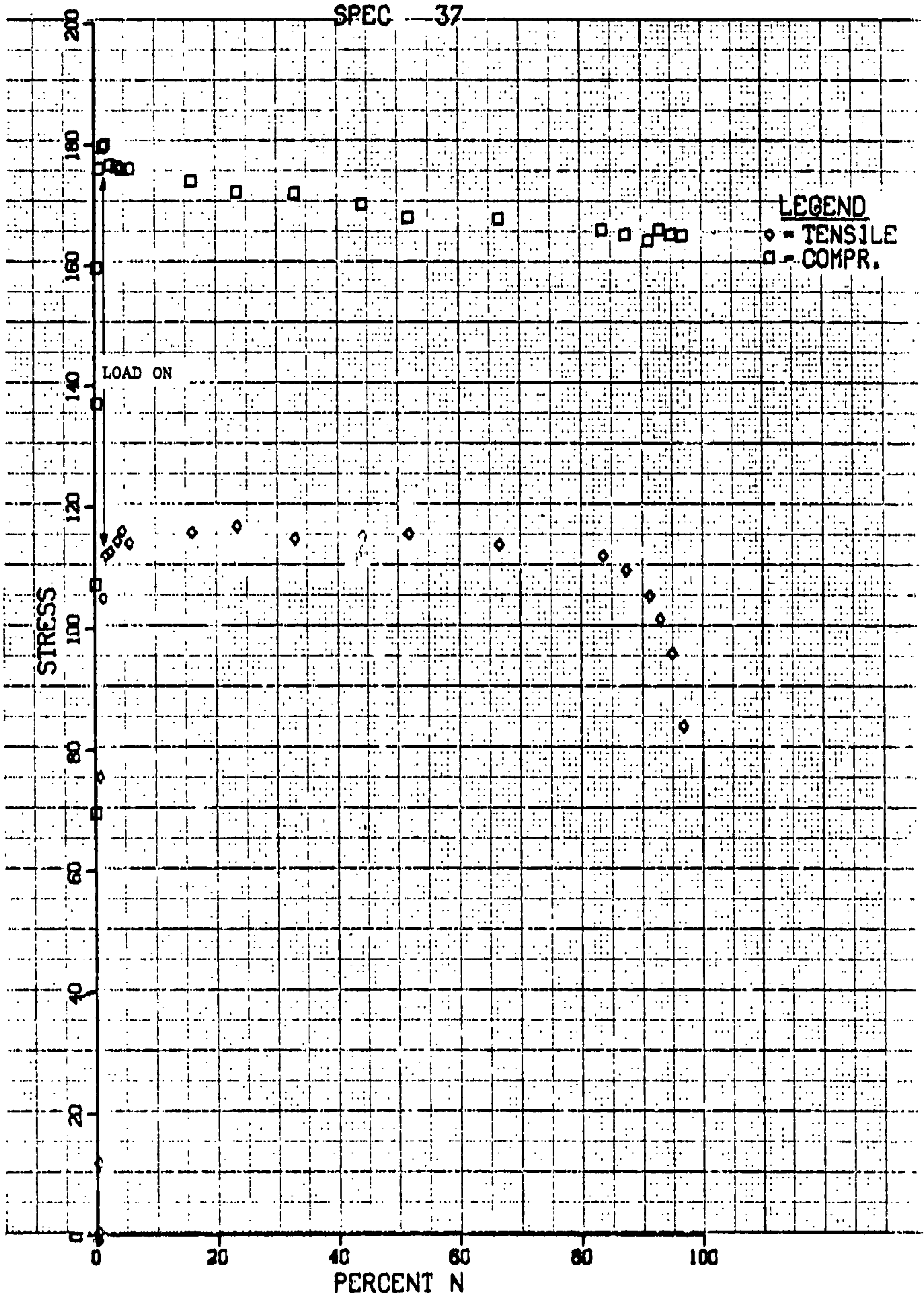

SPEC 37
LEGEND
◇ - TENSILE
□ - COMPR.
LOAD ON
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N

Figure 20.

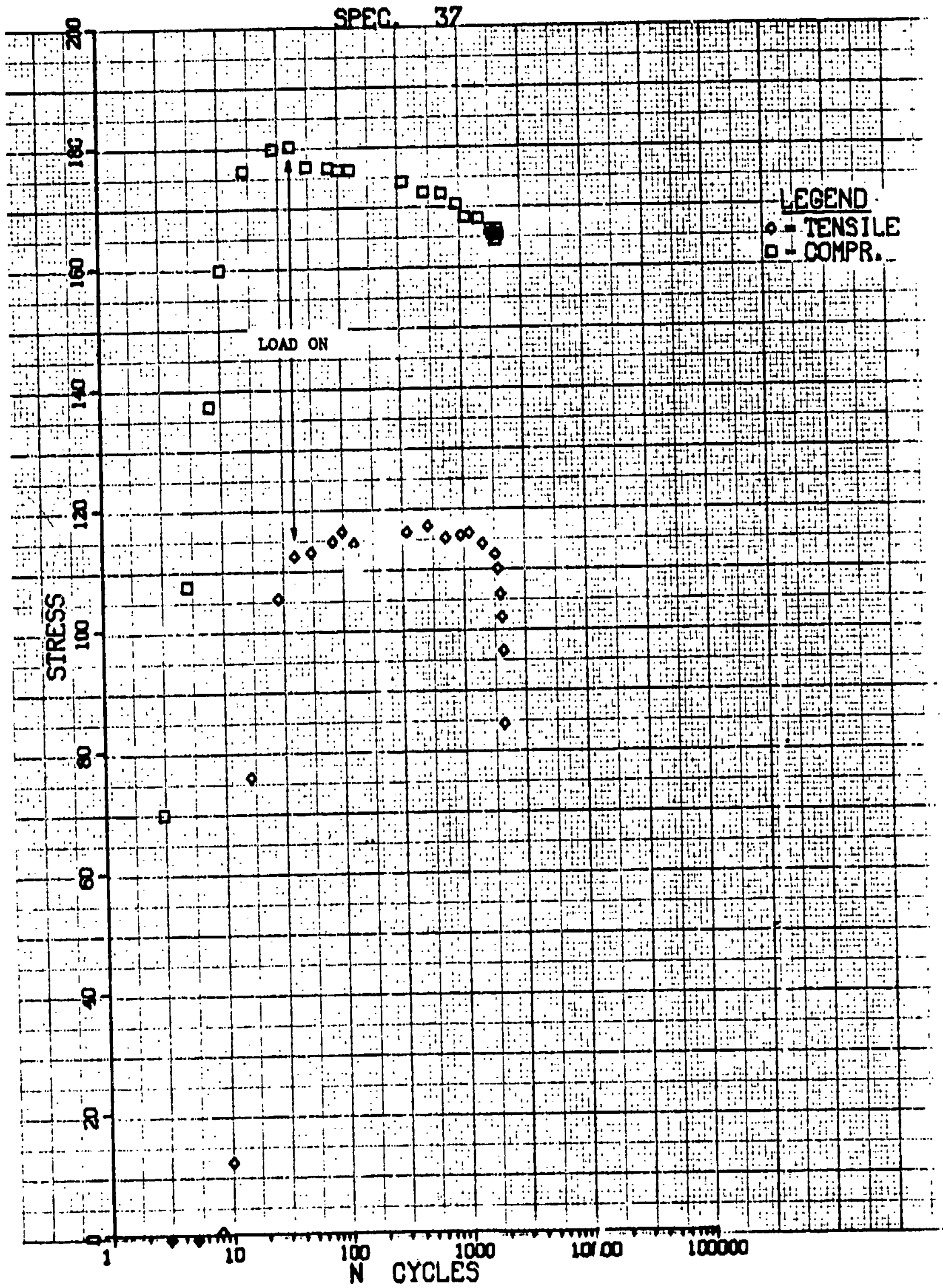

SPEC. 37
LEGEND
◇ - TENSILE
□ - COMPR.
LOAD ON
STRESS
200
180
160
140
120
100
80
60
40
20
1
10
100
1000
10000
100000
N CYCLES

Figure 21.

TABLE 16

SPECIMEN 20

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	.33	164.	0.0	178.	0.0
2	2.	.66	166.	0.0	180.	0.0
3	3.	.99	166.	0.0	181.	0.0
4	4.	1.32	166.	0.0	181.	0.0
5	5.	1.65	166.	0.0	182.	0.0
6	6.	1.98	166.	0.0	182.	0.0
7	7.	2.31	166.	0.0	183.	0.0
8	8.	2.64	165.	0.0	182.	0.0
9	9.	2.97	166.	0.0	183.	0.0
10	10.	3.30	165.	0.0	183.	0.0
11	20.	6.60	165.	0.0	185.	0.0
12	30.	9.90	165.	0.0	185.	0.0
13	40.	13.20	165.	0.0	184.	0.0
14	50.	16.50	165.	0.0	184.	0.0
15	60.	19.80	165.	0.0	184.	0.0
16	70.	23.10	165.	0.0	185.	0.0
17	79.	26.07	165.	0.0	183.	0.0
18	80.	26.40	165.	0.0	181.	0.0
19	81.	26.73	165.	0.0	182.	0.0
20	90.	29.70	164.	0.0	183.	0.0
21	100.	33.00	163.	0.0	184.	0.0
22	110	36.30	164.	0.0	182.	0.0
23	117.	38.61	164.	0.0	183.	0.0
24	120.	39.60	164.	0.0	181.	0.0
25	123.	40.59	162.	0.0	181.	0.0
26	128.	42.24	164.	0.0	181.	0.0
27	130.	42.90	164.	0.0	181.	0.0
28	140.	46.20	162.	0.0	180.	0.0
29	150.	49.50	162.	0.0	180.	0.0
30	160.	52.81	162.	0.0	180.	0.0
31	170.	56.11	161.	0.0	180.	0.0
32	180.	59.41	161.	0.0	180.	0.0
33	190.	62.71	161.	0.0	179.	0.0
34	200.	66.01	160.	0.0	176.	0.0
35	210.	69.31	160.	0.0	176.	0.0
36	220.	72.61	160.	0.0	176.	0.0
37	230.	75.91	160.	0.0	175.	0.0
38	240.	79.21	160.	0.0	175.	0.0
39	250.	82.51	160.	0.0	175.	0.0
40	260.	85.81	160.	0.0	175.	0.0
41	265.	87.46	160.	0.0	174.	0.0
42	270.	89.11	159.	0.0	174.	0.0
43	272.	89.77	160.	0.0	173.	0.0
44	273.	90.10	158.	0.0	176.	0.0
45	274.	90.43	159.	0.0	174.	0.0
46	280.	92.41	160.	0.0	175.	0.0
47	285.	94.06	160.	0.0	175.	0.0
48	290.	95.71	160.	0.0	175.	0.0
49	292.	96.37	162.	0.0	175.	0.0
50	293.	96.70	165.	0.0	175.	0.0
51	294.	97.03	165.	0.0	175.	0.0
52	295.	97.36	159.	0.0	175.	0.0
53	296.	97.69	159.	0.0	173.	0.0
54	297.	98.02	160.	0.0	175.	0.0
55	298.	98.35	160.	0.0	173.	0.0
56	299.	98.68	161.	0.0	174.	0.0
57	300.	99.01	168.	0.0	175.	0.0
58	301.	99.34	169.	0.0	176.	0.0
59	302.	99.67	169.	0.0	176.	0.0
60	303.		160.	0.0	179.	0.0

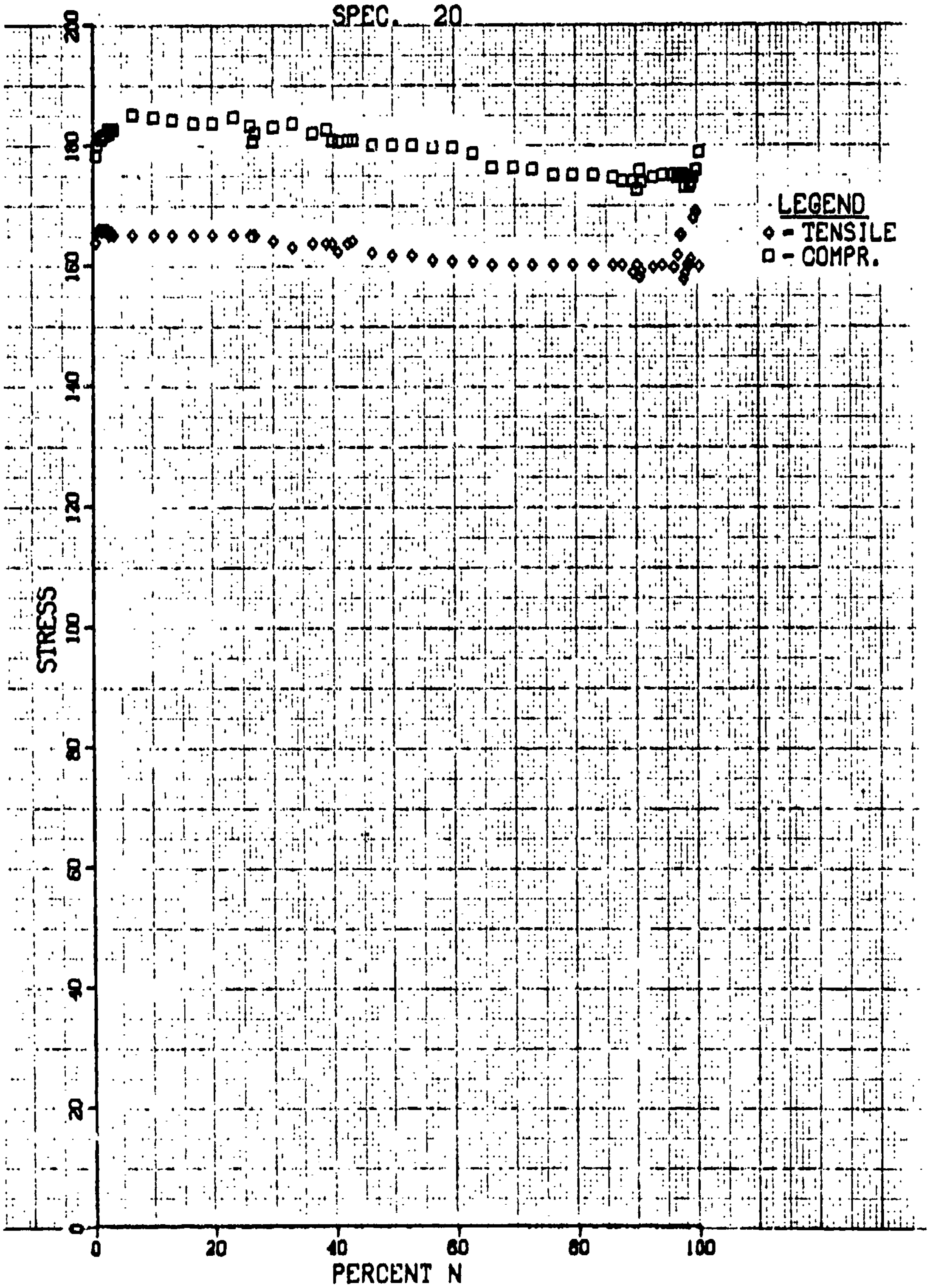
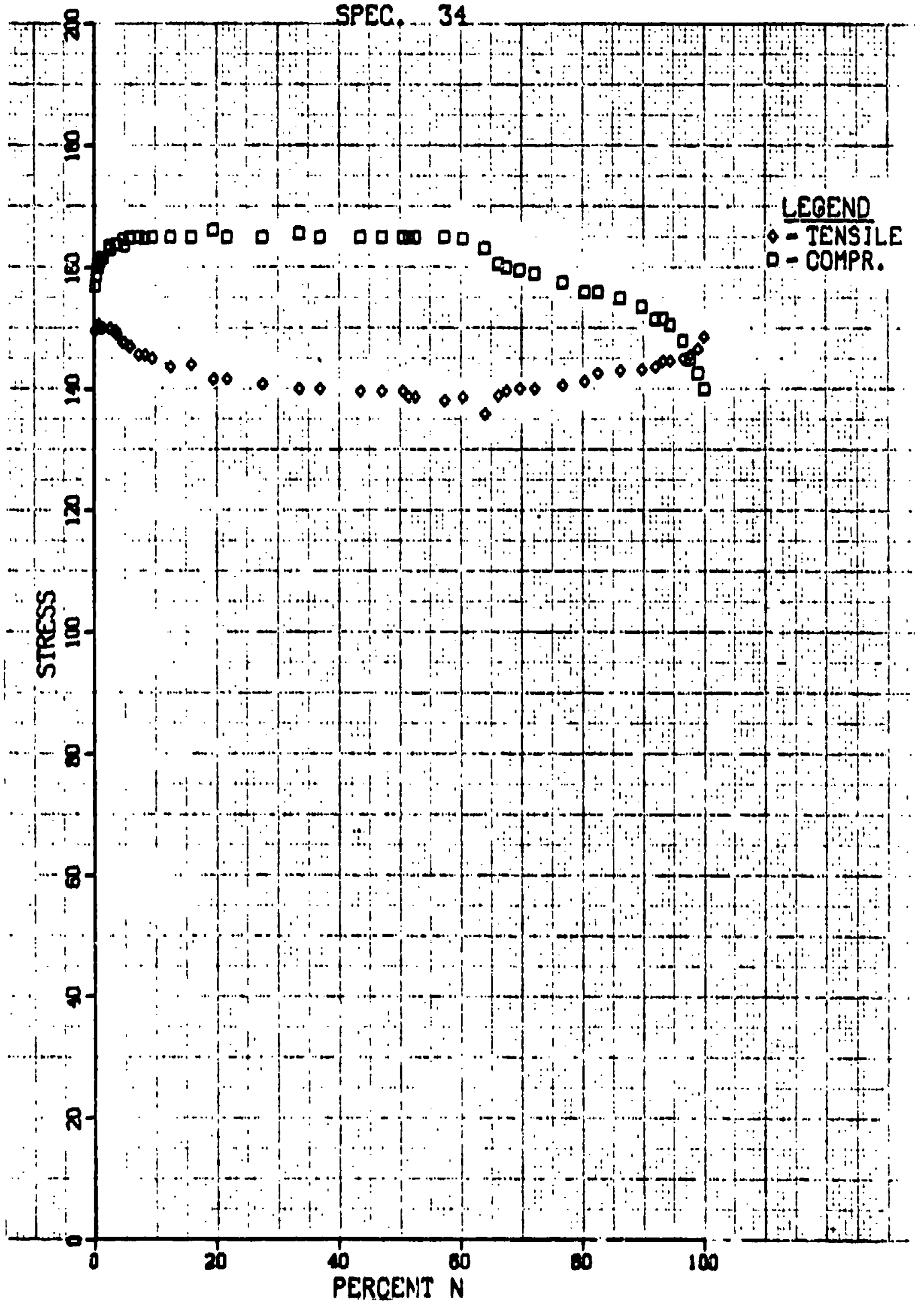

SPEC. 20
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N
LEGEND
◇ - TENSILE
□ - COMPR.

Figure 22.

TABLE 17

Specimen 34

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	.19	150.	0.0	157.	0.0
2	2.	.39	150.	0.0	159.	0.0
3	3.	.58	150.	0.0	161.	0.0
4	4.	.78	151.	0.0	160.	0.0
5	5.	.97	150.	0.0	161.	0.0
6	6.	1.17	150.	0.0	162.	0.0
7	7.	1.36	150.	0.0	162.	0.0
8	8.	1.56	150.	0.0	162.	0.0
9	13.	2.53	150.	0.0	164.	0.0
10	14.	2.73	150.	0.0	163.	0.0
11	18.	3.51	150.	0.0	164.	0.0
12	19.	3.70	149.	0.0	164.	0.0
13	25.	4.87	148.	0.0	165.	0.0
14	26.	5.07	148.	0.0	164.	0.0
15	30.	5.85	147.	0.0	165.	0.0
16	31.	6.04	147.	0.0	165.	0.0
17	38.	7.41	146.	0.0	165.	0.0
18	43.	8.38	146.	0.0	165.	0.0
19	49.	9.55	145.	0.0	165.	0.0
20	65.	12.67	144.	0.0	165.	0.0
21	82.	15.98	144.	0.0	165.	0.0
22	100.	19.49	142.	0.0	166.	0.0
23	112.	21.83	142.	0.0	165.	0.0
24	142.	27.68	141.	0.0	165.	0.0
25	172.	33.53	140.	0.0	166.	0.0
26	190.	37.04	140.	0.0	165.	0.0
27	224.	43.66	140.	0.0	165.	0.0
28	242.	47.17	140.	0.0	165.	0.0
29	260.	50.68	140.	0.0	165.	0.0
30	270.	52.63	139.	0.0	165.	0.0
31	265.	51.66	139.	0.0	165.	0.0
32	294.	57.31	138.	0.0	165.	0.0
33	310.	60.43	139.	0.0	165.	0.0
34	328.	63.94	136.	0.0	163.	0.0
35	340.	66.28	139.	0.0	161.	0.0
36	347.	67.64	140.	0.0	160.	0.0
37	358.	69.79	140.	0.0	160.	0.0
38	370.	72.12	140.	0.0	159.	0.0
39	394.	76.80	141.	0.0	158.	0.0
40	412.	80.31	141.	0.0	156.	0.0
41	424.	82.65	143.	0.0	156.	0.0
42	442.	86.16	143.	0.0	155.	0.0
43	461.	89.86	143.	0.0	154.	0.0
44	472.	92.01	144.	0.0	152.	0.0
45	478.	93.18	145.	0.0	152.	0.0
46	484.	94.35	145.	0.0	151.	0.0
47	496.	96.69	145.	0.0	148.	0.0
48	502.	97.86	146.	0.0	145.	0.0
49	508.	99.03	147.	0.0	143.	0.0
50	513.	100.00	149.	0.0	140.	0.0



SPEC. 34
LEGEND
◇ - TENSILE
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N

Figure 23.

SECTION 8
RENE 95 SLOW-FAST AND FAST-SLOW TESTS

This section is composed of data from the slow-fast and fast-slow tests conducted using René 95. These data are presented in Tables 18 through 22 and Figures 24 through 31.

TABLE 18

SPECIMEN 251

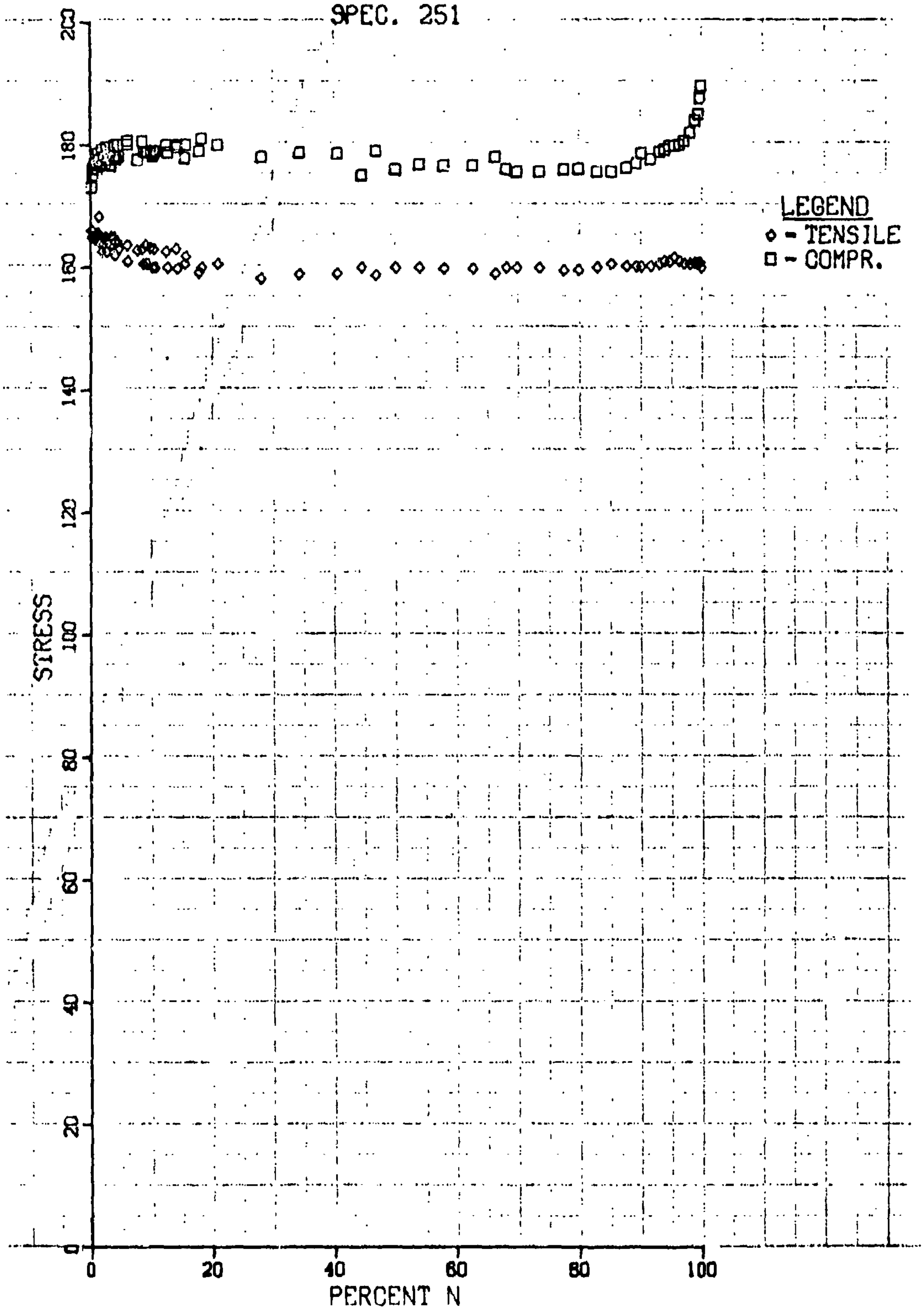
I	N	%N	STRESSES TENSILE	STRESSES RELAXED	STRESSES COMPR.	STRESSES RELAXED
1	1.	.15	155.	0.0	173.	0.0
2	2.	.31	155.	0.0	175.	0.0
3	3.	.47	155.	0.0	176.	0.0
4	4.	.63	155.	0.0	177.	0.0
5	5.	.78	155.	0.0	176.	0.0
6	6.	.94	155.	0.0	176.	0.0
7	7.	1.10	155.	0.0	176.	0.0
8	8.	1.25	166.	0.0	179.	0.0
9	9.	1.41	163.	0.0	174.	0.0
10	10.	1.57	164.	0.0	177.	0.0
11	11.	1.72	165.	0.0	177.	0.0
12	12.	1.88	165.	0.0	179.	0.0
13	13.	2.04	163.	0.0	178.	0.0
14	14.	2.19	164.	0.0	178.	0.0
15	16.	2.51	165.	0.0	177.	0.0
16	17.	2.66	165.	0.0	180.	0.0
17	18.	2.82	163.	0.0	178.	0.0
18	19.	2.98	164.	0.0	178.	0.0
19	21.	3.29	165.	0.0	179.	0.0
20	22.	3.45	164.	0.0	177.	0.0
21	23.	3.61	165.	0.0	177.	0.0
22	25.	3.92	165.	0.0	178.	0.0
23	26.	4.08	164.	0.0	180.	0.0
24	27.	4.23	162.	0.0	178.	0.0
25	28.	4.39	164.	0.0	178.	0.0
26	29.	4.55	164.	0.0	180.	0.0
27	30.	4.70	163.	0.0	178.	0.0
28	39.	6.11	164.	0.0	181.	0.0
29	40.	6.27	161.	0.0	180.	0.0
30	50.	7.84	163.	0.0	178.	0.0
31	55.	8.62	163.	0.0	181.	0.0
32	56.	8.78	161.	0.0	179.	0.0
33	58.	9.09	164.	0.0	179.	0.0
34	60.	9.40	161.	0.0	179.	0.0
35	64.	10.03	163.	0.0	179.	0.0
36	66.	10.34	160.	0.0	178.	0.0
37	67.	10.50	163.	0.0	179.	0.0
38	69.	10.82	160.	0.0	179.	0.0
39	80.	12.54	163.	0.0	180.	0.0
40	82.	12.85	160.	0.0	179.	0.0
41	90.	14.11	163.	0.0	180.	0.0

Table continued on following page.

TABLE 18 Continued

SPECIMEN 231

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			STRESSES			
42	92.	14.42	160.	0.0	180.	0.0
43	99.	15.52	161.	0.0	178.	0.0
44	101.	15.83	162.	0.0	180.	0.0
45	115.	18.03	159.	0.0	179.	0.0
46	117.	18.34	160.	0.0	181.	0.0
47	134.	21.00	161.	0.0	180.	0.0
48	180.	28.21	159.	0.0	178.	0.0
49	220.	34.48	159.	0.0	179.	0.0
50	259.	40.60	159.	0.0	179.	0.0
51	285.	44.67	160.	0.0	175.	0.0
52	300.	47.02	159.	0.0	179.	0.0
53	320.	50.16	160.	0.0	176.	0.0
54	345.	54.08	160.	0.0	177.	0.0
55	370.	57.99	160.	0.0	177.	0.0
56	400.	62.70	160.	0.0	177.	0.0
57	423.	66.30	159.	0.0	178.	0.0
58	435.	68.18	160.	0.0	176.	0.0
59	446.	69.91	160.	0.0	176.	0.0
60	470.	73.67	160.	0.0	176.	0.0
61	495.	77.59	160.	0.0	176.	0.0
62	510.	79.94	160.	0.0	176.	0.0
63	530.	83.07	160.	0.0	176.	0.0
64	545.	85.42	161.	0.0	176.	0.0
65	560.	87.77	160.	0.0	176.	0.0
66	570.	89.34	160.	0.0	177.	0.0
67	575.	90.13	160.	0.0	179.	0.0
68	585.	91.69	160.	0.0	178.	0.0
69	595.	93.26	161.	0.0	179.	0.0
70	600.	94.04	161.	0.0	179.	0.0
71	605.	94.83	161.	0.0	180.	0.0
72	610.	95.61	162.	0.0	180.	0.0
73	615.	96.39	161.	0.0	180.	0.0
74	620.	97.18	161.	0.0	181.	0.0
75	627.	98.28	161.	0.0	182.	0.0
76	632.	99.06	161.	0.0	184.	0.0
77	635.	99.53	161.	0.0	185.	0.0
78	637.	99.84	161.	0.0	188.	0.0
79	638.		160.	0.0	190.	0.0



SPEC. 251
STRESS
PERCENT N
LEGEND
◇ - TENSILE
□ - COMPR.
0
20
40
60
80
100
120
140
160
180
200

Figure 24.

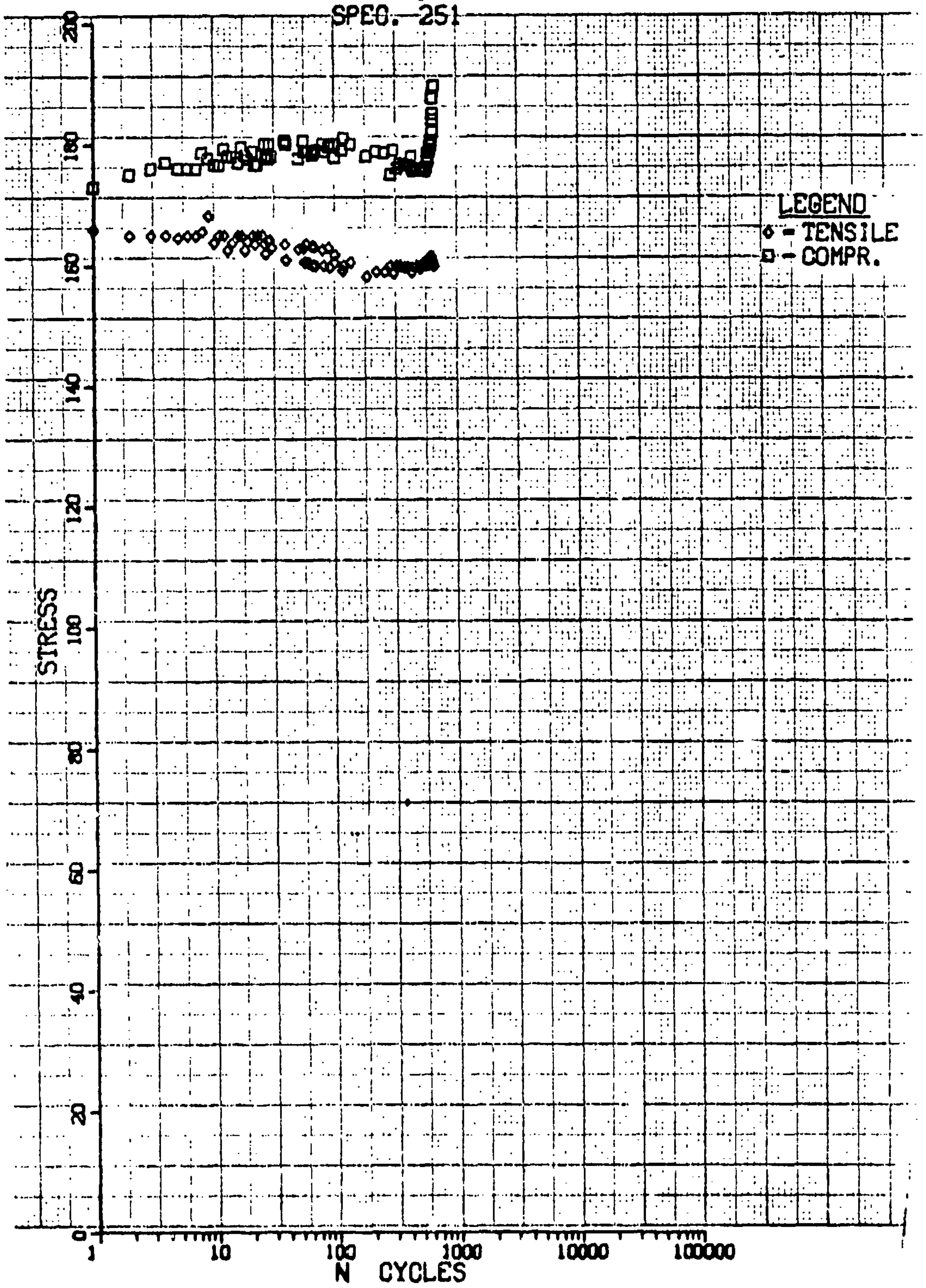

SPEC. 251
LEGEND
◇ - TENSILE
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 25.

TABLE 19

SPECIMEN 262

I	N	%N	STRESSES TENSILE	RELAXED[1]	COMPR.	RELAXED
1	1.	0.	143.	73.8	151.	0.0
2	2.	0.	144.	78.8	150.	0.0
3	3.	0.	144.	76.3	150.	0.0
4	10.	1.	140.	77.5	154.	0.0
5	20.	2.	141.	78.8	154.	0.0
6	40.	4.	140.	77.5	153.	0.0
7	88.	8.	138.	76.3	156.	0.0
8	120.	11.	140.	77.5	153.	0.0
9	413.	38.	145.	80.0	148.	0.0
10	160.	15.	143.	80.0	150.	0.0
11	455.	42.	141.	78.8	150.	0.0
12	545.	50.	143.	75.0	149.	0.0
13	620.	57.	145.	78.8	148.	0.0
14	903.	83.	143.	77.5	145.	0.0
15	1006.	93.	140.	77.5	145.	0.0
16	1035.	95.	138.	75.0	145.	0.0
17	1048.	97.	135.	75.0	148.	0.0
18	1071.	99.	128.	72.5	145.	0.0
19	1083.	100.	123.	75.0	150.	0.0
20	1084.	100.	120.	72.5	151.	0.0
21	1085.	100.	118.	75.0		0.0

[1]Tensile stress minus the relaxed stress is equal to the stress at which the rate change was made.

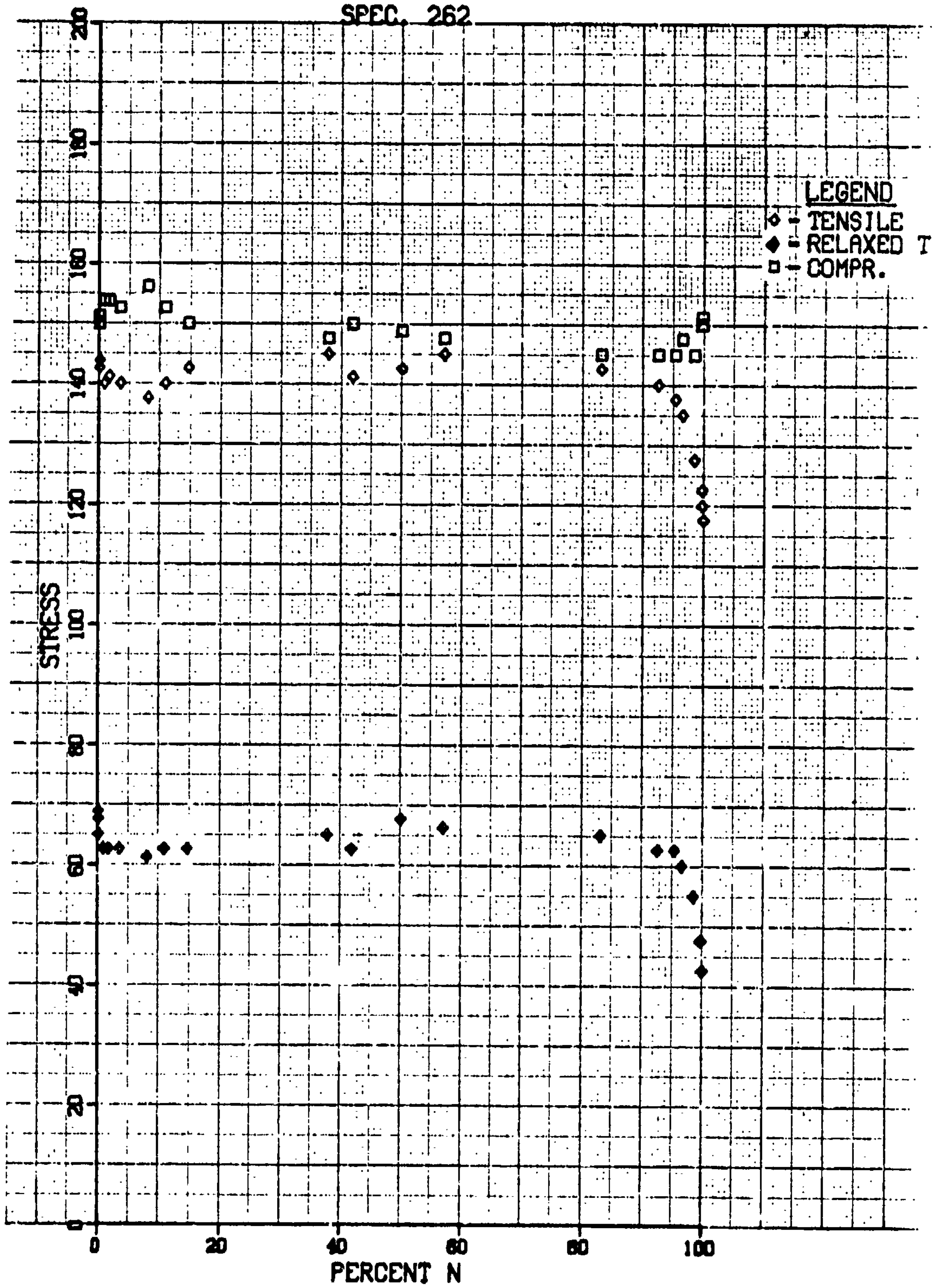

SPEC. 262
LEGEND
TENSILE
RELAXED T
COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N
0
20
40
60
80
100

Figure 26.

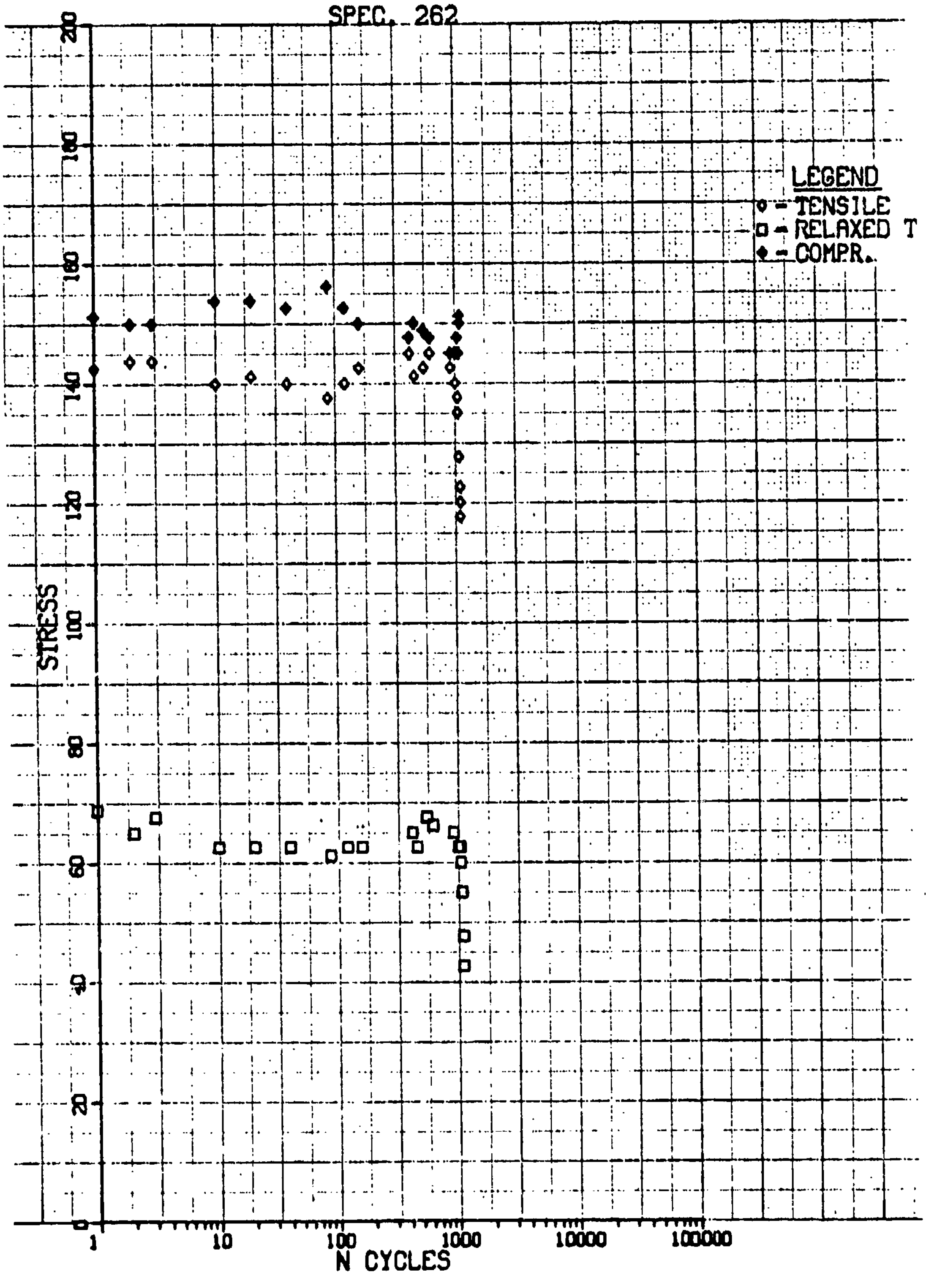

SPEC. 262
STRESS
200
180
160
140
120
100
80
60
40
20
1
10
100
1000
10000
100000
N CYCLES
LEGEND
◇ - TENSILE
□ - RELAXED T
◆ - COMPR.

Figure 27.

TABLE 20

SPECIMEN 252

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	.52	170.	0.0	178.	0.0
2	2.	1.03	169.	0.0	176.	0.0
3	3.	1.55	169.	0.0	176.	0.0
4	4.	2.06	169.	0.0	176.	0.0
5	5.	2.58	168.	0.0	177.	0.0
6	6.	3.09	169.	0.0	177.	0.0
7	7.	3.61	169.	0.0	175.	0.0
8	8.	4.12	170.	0.0	175.	0.0
9	9.	4.64	169.	0.0	175.	0.0
10	10.	5.15	170.	0.0	175.	0.0
11	15.	7.73	170.	0.0	174.	0.0
12	25.	12.89	170.	0.0	174.	0.0
13	40.	20.62	168.	0.0	175.	0.0
14	55.	28.35	168.	0.0	175.	0.0
15	65.	33.51	167.	0.0	175.	0.0
16	85.	43.81	166.	0.0	175.	0.0
17	95.	48.97	166.	0.0	175.	0.0
18	116.	59.79	164.	0.0	176.	0.0
19	130.	67.01	164.	0.0	176.	0.0
20	145.	74.74	163.	0.0	176.	0.0
21	160.	82.47	162.	0.0	176.	0.0
22	170.	87.63	161.	0.0	176.	0.0
23	180.	92.78	160.	0.0	176.	0.0
24	185.	95.36	159.	0.0	176.	0.0
25	188.	96.91	157.	0.0	176.	0.0
26	190.	97.94	155.	0.0	177.	0.0
27	193.	99.48	152.	0.0	178.	0.0
28	194.	100.00	142.	0.0	178.	0.0

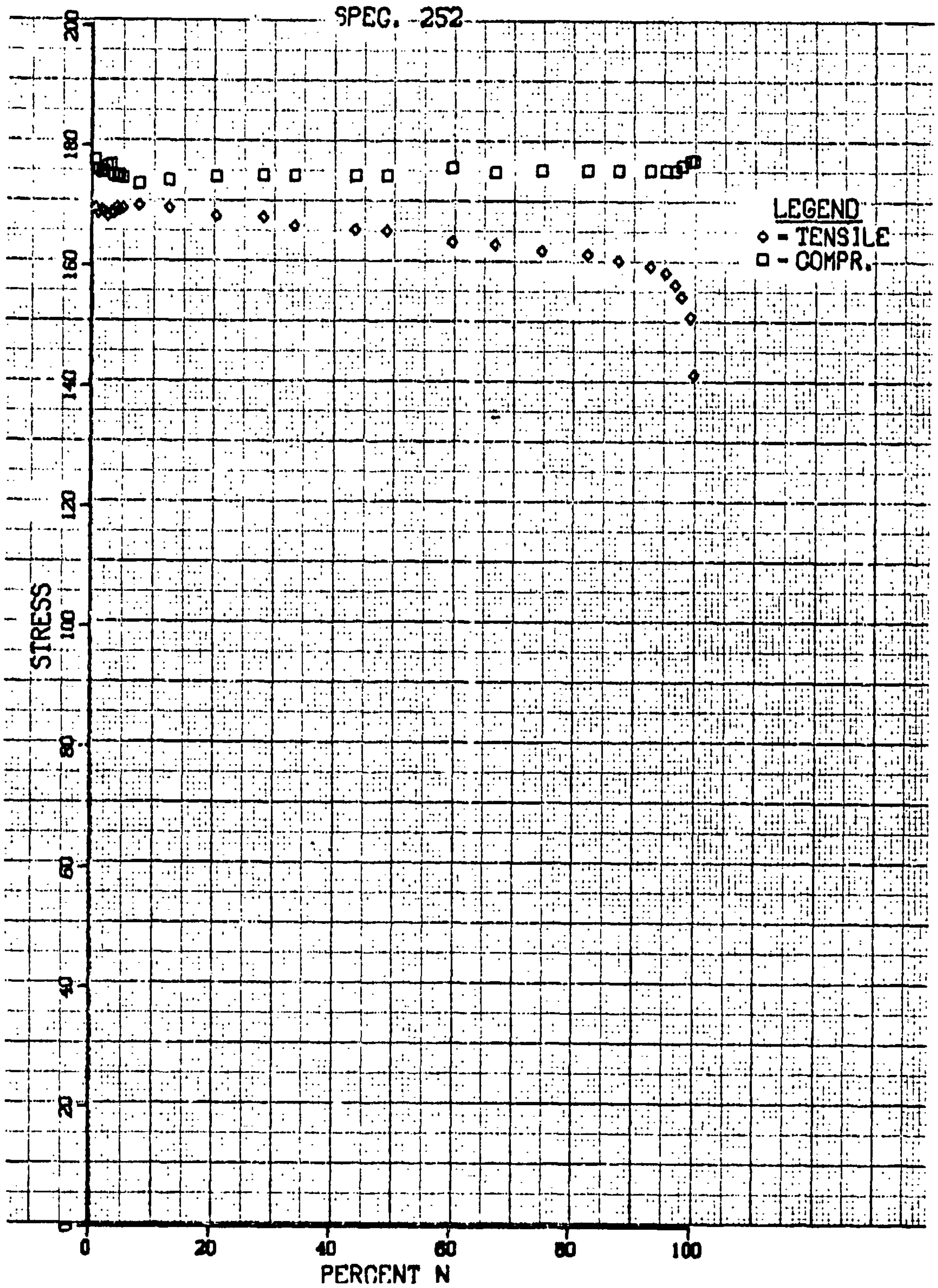

SPEC. 252
STRESS
PERCENT N
LEGEND
◇ - TENSILE
□ - COMPR.
0
20
40
60
80
100
120
140
160
180
200

Figure 28.

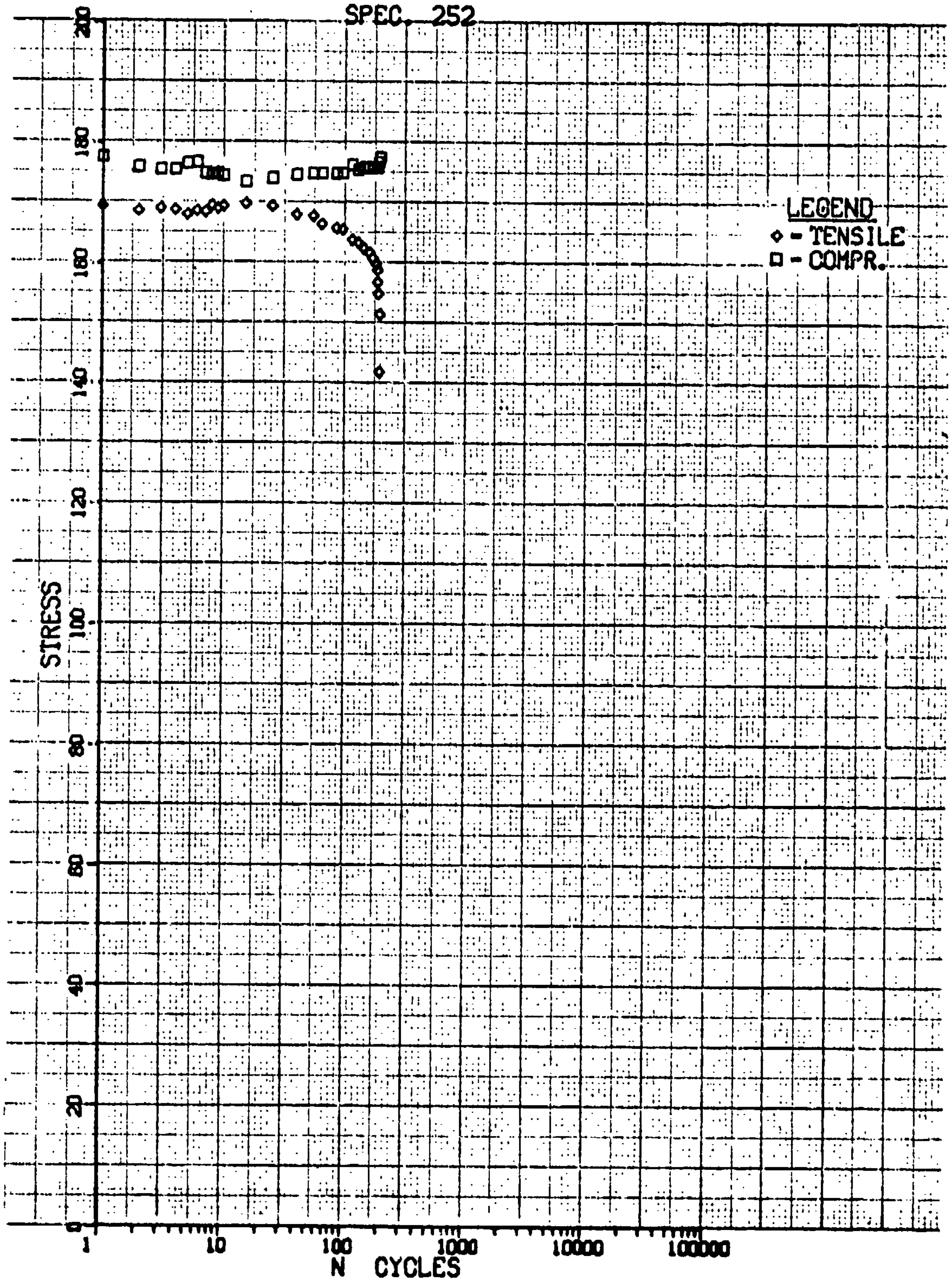

SPEC. 252
LEGEND
◇ - TENSILE
□ - COMPR.
STRESS
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
100000
N CYCLES

Figure 29.

TABLE 21

SPECIMEN 263[2]

I	N	%N	PEAK TENSILE	HELD TENSILE	RELAXED TENSILE	PEAK COMPR.	HELD COMPR.[1]
1	1.	0.	120.	0.	0.0	118.	58.
2	2.	0.	121.	0.	0.0	119.	59.
3	3.	1.	121.	0.	0.0	119.	59.
4	10.	2.	120.	0.	0.0	120.	60.
5	13.	3.	118.	0.	0.0	122.	62.
6	17.	3.	116.	0.	0.0	124.	64.
7	54.	10.	120.	0.	0.0	121.	62.
8	66.	13.	122.	0.	0.0	119.	58.
9	74.	14.	124.	0.	0.0	117.	56.
10	93.	18.	123.	0.	0.0	118.	58.
11	94.	18.	111.	0.	0.0	123.	70.
12	95.	18.	112.	0.	0.0	129.	66.
13	96.	18.	112.	0.	0.0	125.	64.
14	150.	29.	116.	0.	0.0	124.	64.
15	200.	38.	111.	0.	0.0	130.	70.
16	210.	40.	110.	0.	0.0	130.	70.
17	220.	42.	109.	0.	0.0	132.	71.
18	240.	46.	108.	0.	0.0	133.	73.
19	250.	48.	111.	0.	0.0	130.	70.
20	265.	51.	114.	0.	0.0	127.	68.
21	277.	53.	114.	0.	0.0	127.	68.
22	283.	54.	162.	0.	0.0	165.	
23	288.	55.	164.	0.	0.0	166.	
24	307.	59.	164.	0.	0.0	167.	
25	332.	64.	162.	0.	0.0	169.	
26	347.	67.	160.	0.	0.0	171.	
27	417.	80.	160.	0.	0.0	170.	
28	431.	83.	160.	0.	0.0	168.	
29	438.	84.	159.	0.	0.0	169.	
30	442.	85.	160.	0.	0.0	165.	
31	497.	96.	162.	0.	0.0	164.	
32	519.	100.	168.	0.	0.0	156.	
33	525.	101.	168.	0.	0.0	155.	

[1] This stress is the compressive stress at which the rate change was made.

[2] Two different histories were imposed on this specimen. Everything above the dashed line was a 0.05-½-20 cpm test at a total strain-range of 0.97%. Everything below the dashed line was a 0.05-20 cpm test at a total strain-range of 1.4%. This condition was run until failure.

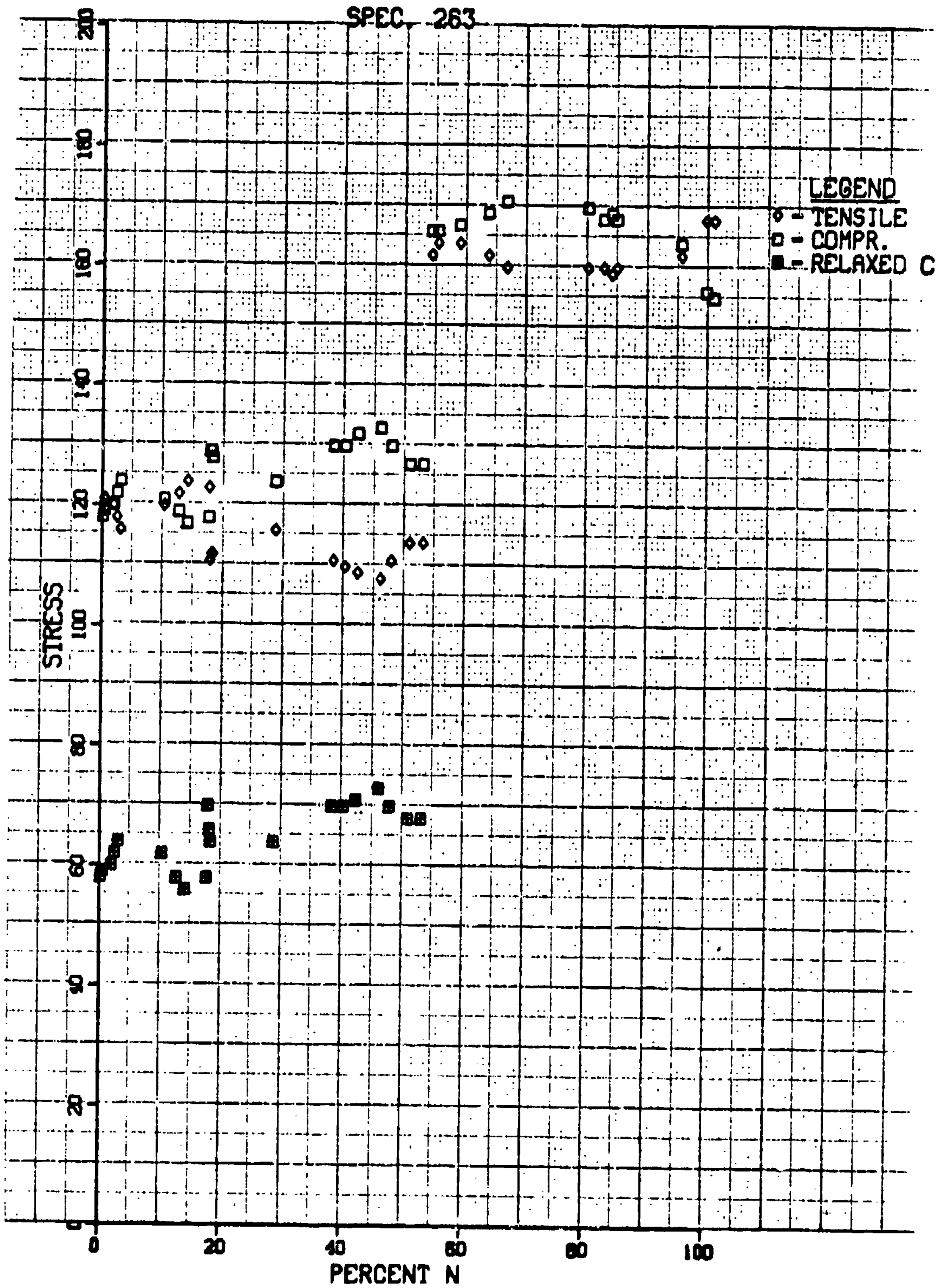

SPEC. 263
LEGEND
◇ - TENSILE
□ - COMPR.
■ - RELAXED C
STRESS
200
180
160
140
120
100
80
60
40
20
0
0
20
40
60
80
100
PERCENT N

Figure 30.

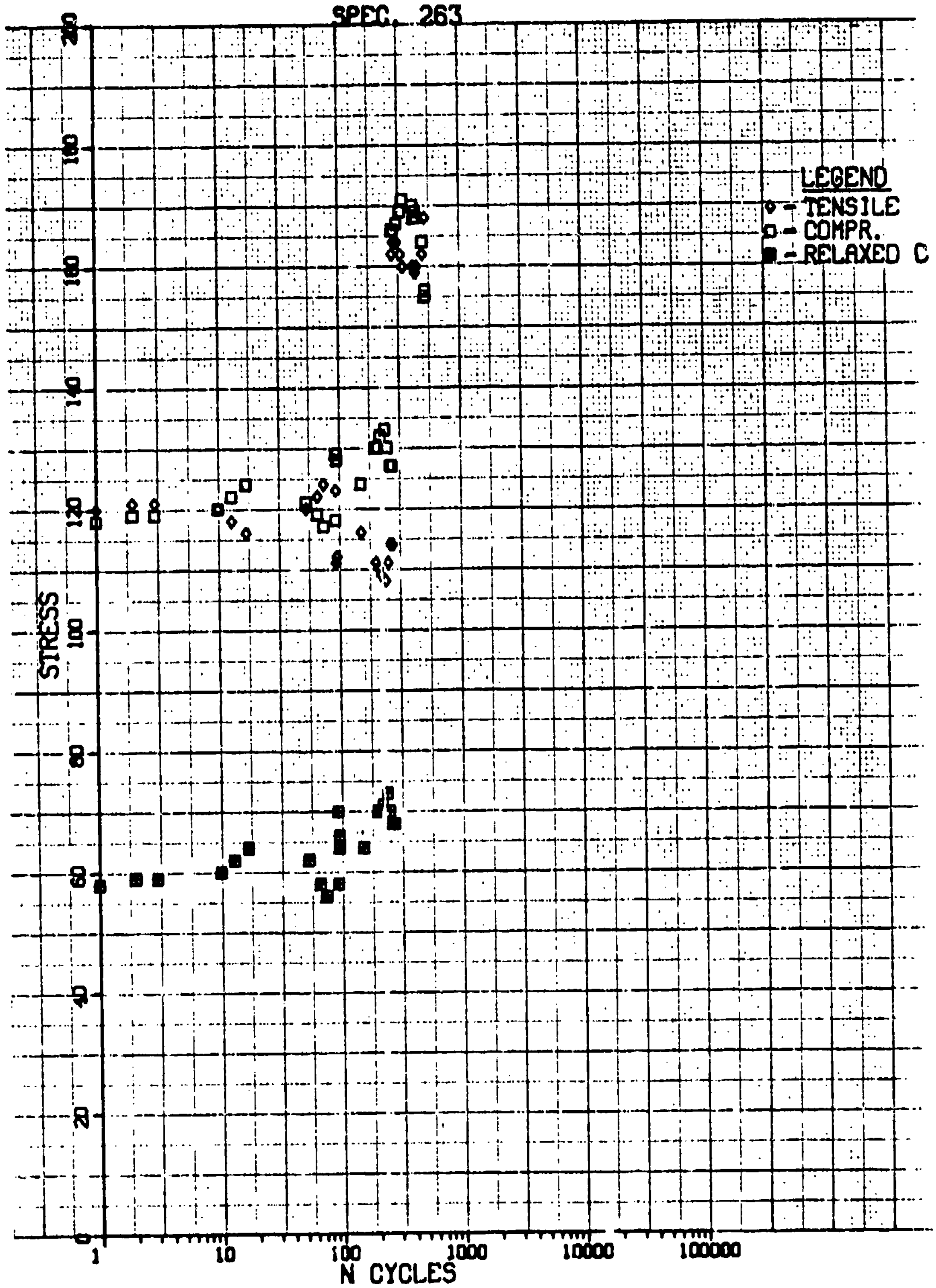

SPEC. 263
LEGEND
◇ - TENSILE
□ - COMPR.
■ - RELAXED C
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 31.

TABLE 22

SPECIMEN 257[1]

I	N	%N	PEAK TENSILE	HELD TENSILE	RELAXED TENSILE	PEAK COMPR.	HELD[2] COMPR.	RELAXED COMPR.
1	1.	0.	119.	0.	0.0	117.	91.	91.3
2	2.	0.	117.	0.	0.0	122.	98.	98.3
3	3.	0.	117.	0.	0.0	125.	59.	58.5
4	4.	0.	117.	0.	0.0	117.	56.	56.2
5	5.	0.	117.	0.	0.0	119.	56.	56.2
6	6.	0.	117.	0.	0.0	125.	59.	58.5
7	3.	0.	115.	0.	0.0	122.	59.	58.5
8	142.	3.	122.	0.	0.0	117.	54.	53.8
9	240.	5.	126.	0.	0.0	112.	49.	49.1
10	244.	5.	122.	0.	0.0	117.	54.	53.8
11	478.	9.	126.	0.	0.0	112.	49.	49.1
12	481.	9.	122.	0.	0.0	117.	54.	53.8
13	483.	9.	126.	0.	0.0	112.	49.	49.1
14	570.	11.	131.	0.	0.0	105.	42.	42.1
15	544.	10.	129.	0.	0.0	105.	47.	46.8
16	612.	12.	136.	0.	0.0	103.	40.	39.8
17	660.	12.	143.	0.	0.0	95.	30.	30.4
18	661.	13.	136.	0.	0.0	103.	40.	39.8
19	670.	13.	131.	0.	0.0	110.	44.	44.5
20	673.	13.	133.	0.	0.0	105.	42.	42.1
21	700.	13.	131.	0.	0.0	117.	44.	44.5
22	730.	14.	133.	0.	0.0	105.	42.	42.1
23	801.	15.	133.	0.	0.0	105.	40.	39.8
24	1415.	27.	140.	0.	0.0	101.	35.	35.1
25	1417.	27.	140.	0.	0.0	99.	35.	35.1
26	2610.	49.	143.	0.	0.0	94.	30.	30.4
27	2650.	50.	145.	0.	0.0	94.	30.	30.4
28	2654.	50.	75.	0.	0.0	75.	30.	30.4
29	2655.	50.	105.	0.	0.0	87.	28.	28.1
30	2656.	50.	119.	0.	0.0	87.	23.	23.5
31	2657.	50.	126.	0.	0.0	91.	26.	25.7
32	2658.	50.	131.	0.	0.0	91.	26.	25.7
33	2659.	50.	133.	0.	0.0	81.	23.	23.4
34	2660.	50.	133.	0.	0.0	83.	23.	23.4
35	2661.	50.	133.	0.	0.0	81.	21.	21.1
36	2662.	50.	136.	0.	0.0	87.	21.	21.1
37	2663.	50.	136.	0.	0.0	87.	21.	21.1
38	2673.	51.	133.	0.	0.0	87.	21.	21.1
39	2845.	54.	138.	0.	0.0	84.	19.	18.7
40	2855.	54.	136.	0.	0.0	84.	19.	18.7
41	2865.	55.	140.	0.	0.0	82.	16.	16.4
42	2866.	55.	138.	0.	0.0	84.	19.	18.7
43	3254.	62.	140.	0.	0.0	82.	16.	16.4
44	3304.	62.	138.	0.	0.0	84.	16.	16.4
45	3404.	64.	138.	0.	0.0	84.	16.	16.4
46	3929.	74.	135.	0.	0.0	87.	21.	21.1
47	3935.	74.	136.	0.	0.0	87.	21.	21.1
48	3936.	74.	131.	0.	0.0	89.	21.	21.1
49	3941.	75.	136.	0.	0.0	91.	19.	18.7
50	4074.	77.	129.	0.	0.0	94.	26.	25.7
51	4075.	77.	133.	0.	0.0	84.	21.	21.1
52	4229.	80.	133.	0.	0.0	87.	21.	21.1
53	4230.	80.	126.	0.	0.0	94.	26.	25.7
54	4231.	80.	133.	0.	0.0	89.	21.	21.1
55	4234.	81.	131.	0.	0.0		26.	25.7
56	4364.	83.	131.	0.	0.0	91.	23.	23.4
57	4393.	83.	129.	0.	0.0	91.	26.	25.7
58	4397.	83.	131.	0.	0.0	89.	23.	23.4
59	4554.	88.	129.	0.	0.0	91.	26.	25.7
60	4659.	88.	131.	0.	0.0	89.	23.	23.4
61	5288.	100.	131.	0.	0.0	89.	23.	23.4

[1] All the stresses below the dashed line should be multiplied by 1.068 to obtain the correct value.

[2] This is the compressive stress at which the rate change was made.

SECTION 9

RENÉ 95 TENSILE-ONLY STRAIN-HOLD TESTS

Data from tensile-only strain-hold tests on René 95 are presented in Tables 23 through 37 and Figures 32 through 57. The hold periods were for one and ten minutes at the peak tensile strain and for one minute at a tensile strain between the zero and peak strain levels.

TABLE 23

SPECIMEN 5

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			---------STRESSES-------			
1	1.	0.	168.	11.3	180.	0.0
2	2.	1.	169.	18.8	181.	0.0
3	3.	1.	170.	20.0	183.	0.0
4	4.	2.	170.	22.5	183.	0.0
5	6.	2.	170.	21.3	185.	0.0
6	12.	5.	170.	25.0	186.	0.0
7	17.	7.	170.	25.0	188.	0.0
8	25.	10.	169.	23.8	188.	0.0
9	33.	13.	168.	22.5	189.	0.0
10	39.	15.	166.	23.8	190.	0.0
11	40.	16.	166.	21.3	189.	0.0
12	55.	22.	165.	18.8	189.	0.0
13	82.	32.	165.	22.5	189.	0.0
14	85.	33.	164.	22.5	188.	0.0
15	97.	38.	163.	20.0	188.	0.0
16	113.	44.	161.	21.3	188.	0.0
17	131.	51.	160.	16.3	186.	0.0
18	132.	52.	160.	20.0	186.	0.0
19	158.	62.	160.	22.5	188.	0.0
20	160.	63.	160.	20.0	186.	0.0
21	170.	67.	159.	20.0	188.	0.0
22	180.	71.	158.	20.0	186.	0.0
23	197.	77.	156.	18.8	186.	0.0
24	204.	80.	155.	17.5	186.	0.0
25	206.	81.	156.	16.3	184.	0.0
26	207.	81.	158.	20.0	185.	0.0
27	215.	84.	156.	20.0	185.	0.0
28	219.	86.	155.	20.0	186.	0.0
29	238.	93.	154.	18.8	185.	0.0
30	240.	94.	153.	18.5	185.	0.0
31	246.	96.	151.	21.3	185.	0.0
32	254.	100.	151.	20.0	184.	0.0

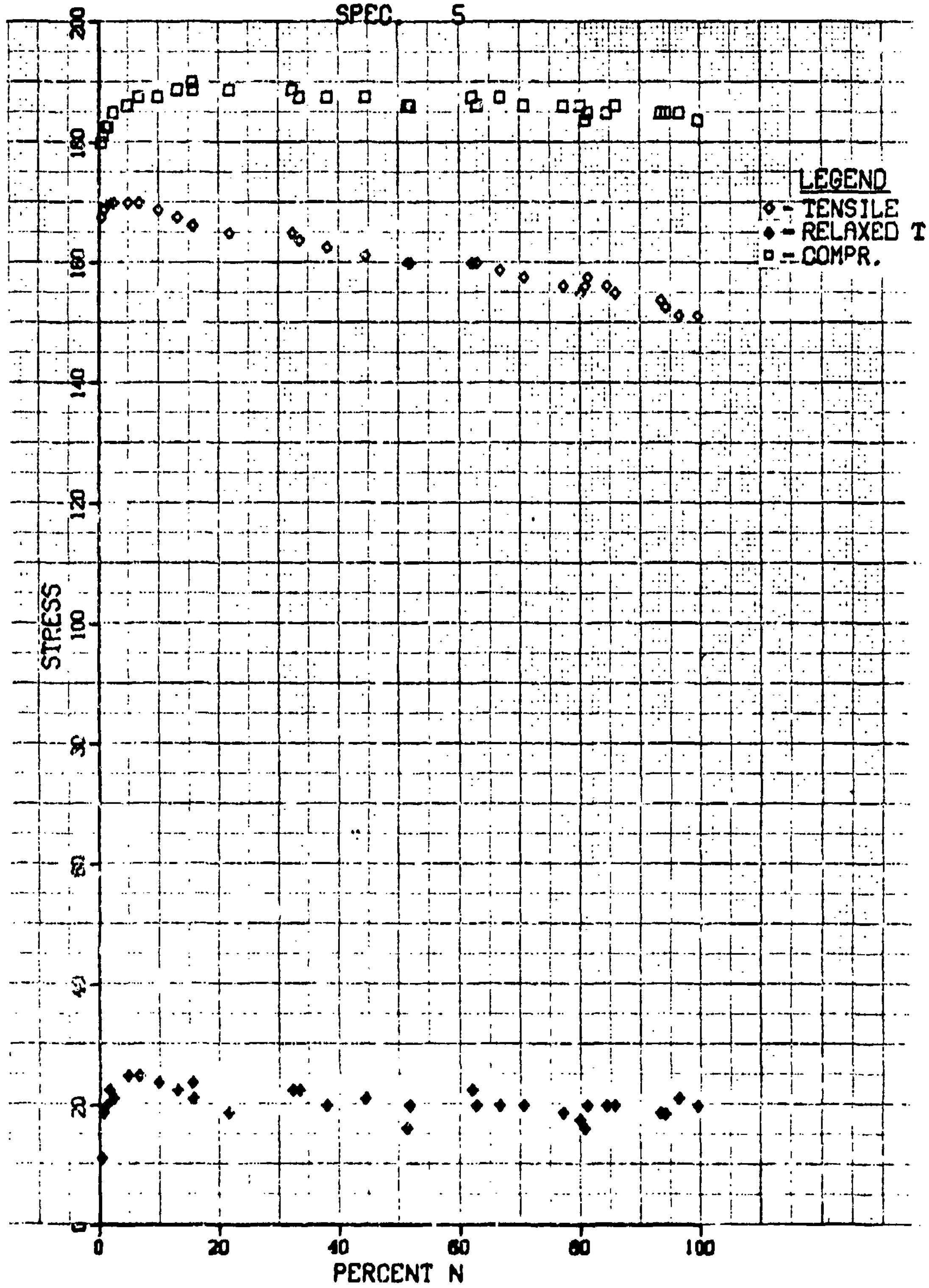

SPEC. 5
STRESS
PERCENT N
LEGEND
- TENSILE
- RELAXED T
- COMPR.
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100

Figure 32.

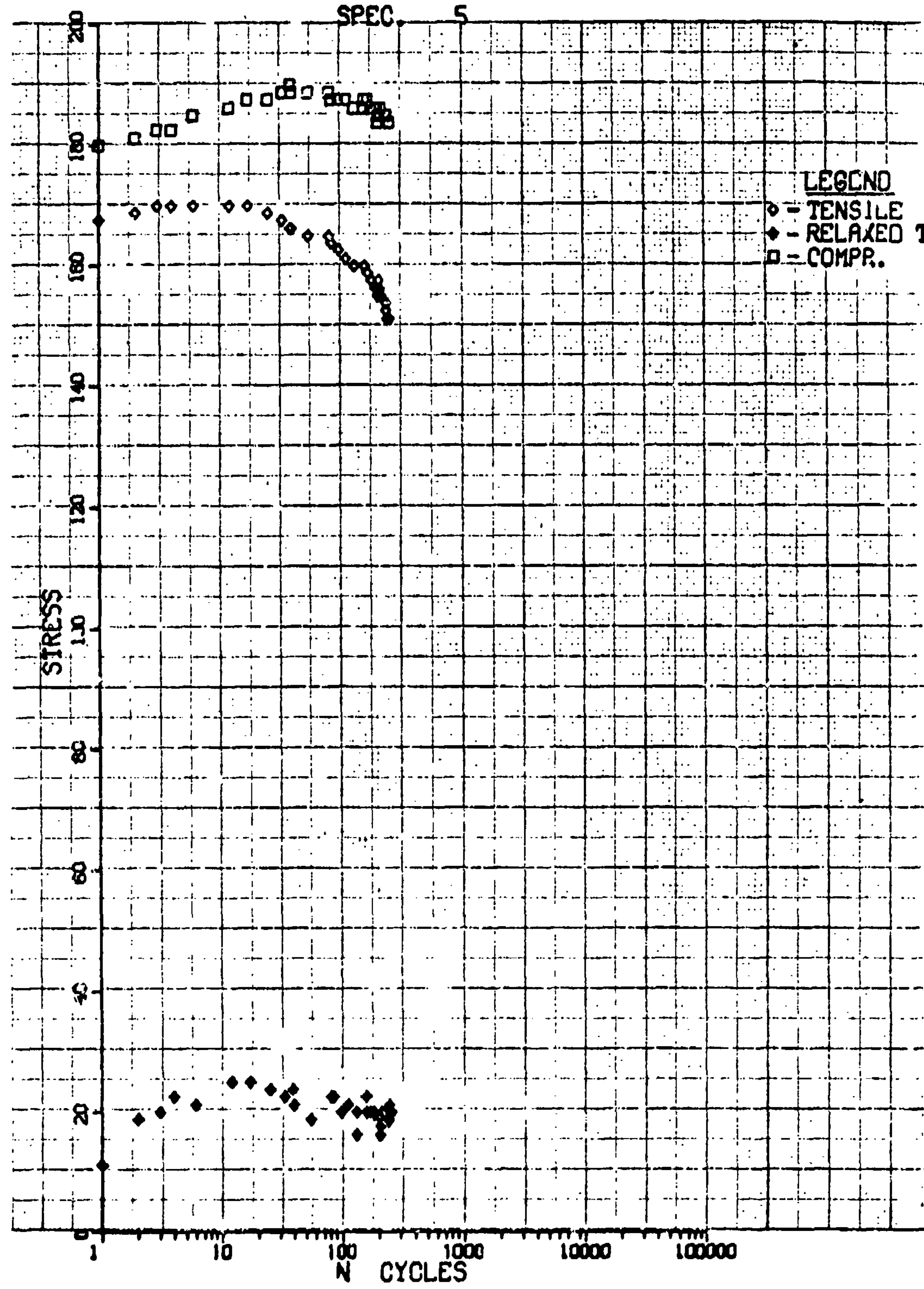
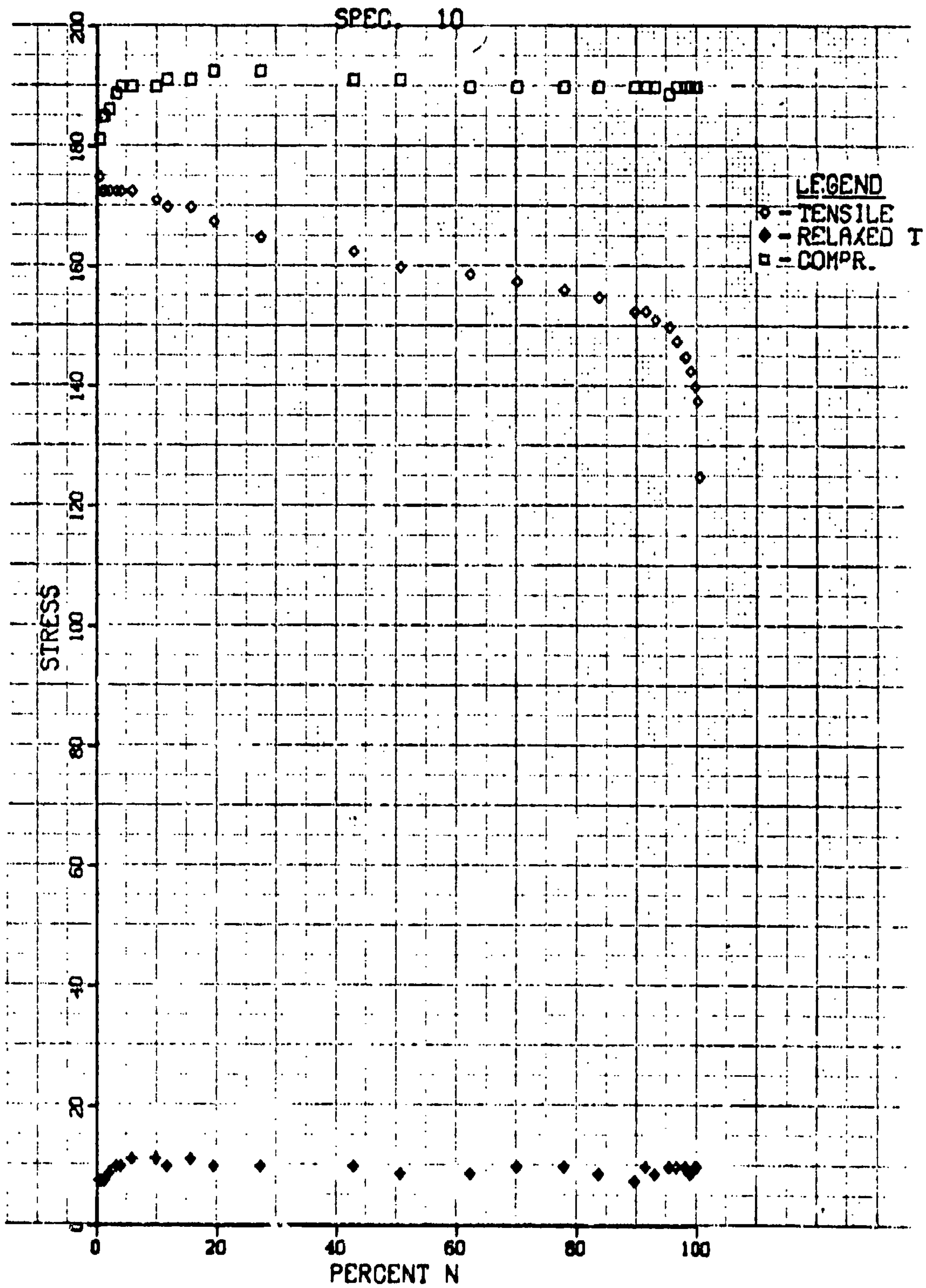

SPEC. 5
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 33.

TABLE 24

SPECIMEN 10

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			---------STRESSES-------			
1	1.	0.	175.	7.5	181.	0.0
2	2.	1.	173.	7.5	185.	0.0
3	3.	1.	173.	7.5	185.	0.0
4	5.	2.	173.	8.8	186.	0.0
5	8.	3.	173.	10.0	189.	0.0
6	10.	4.	173.	10.0	190.	0.0
7	15.	6.	173.	11.3	190.	0.0
8	25.	10.	171.	11.3	190.	0.0
9	30.	12.	170.	10.0	191.	0.0
10	40.	16.	170.	11.3	191.	0.0
11	50.	19.	168.	10.0	193.	0.0
12	70.	27.	165.	10.0	193.	0.0
13	110.	43.	163.	10.0	191.	0.0
14	130.	51.	160.	8.8	191.	0.0
15	160.	62.	159.	8.8	190.	0.0
16	180.	70.	158.	10.0	190.	0.0
17	200.	78.	156.	10.0	190.	0.0
18	215.	84.	155.	8.8	190.	0.0
19	230.	89.	153.	7.5	190.	0.0
20	235.	91.	153.	10.0	190.	0.0
21	239.	93.	151.	8.8	190.	0.0
22	245.	95.	150.	10.0	189.	0.0
23	248.	96.	148.	10.0	190.	0.0
24	252.	98.	145.	10.0	190.	0.0
25	254.	99.	143.	8.8	190.	0.0
26	256.	100.	140.	10.0	190.	0.0
27	257.	100.	138.	10.0	190.	0.0
28	258.	100.	125.			0.0



SPEC. 10
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N

Figure 34.

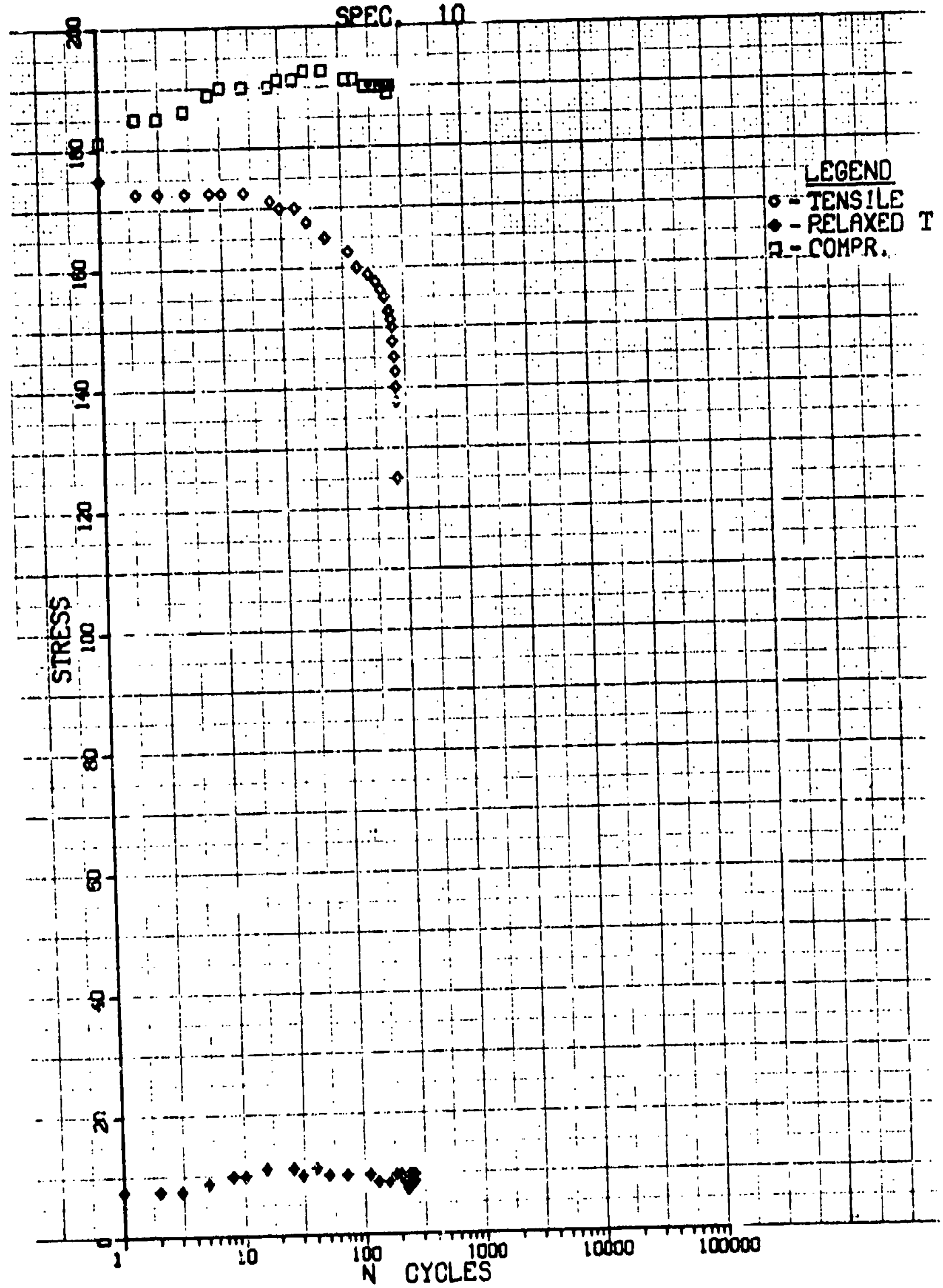

SPEC. 10
STRESS
200
180
160
140
120
100
80
60
40
20
0
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
1
10
100
1000
10000
100000
N CYCLES

Figure 35.

TABLE 25

SPECIMEN 7

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			---------STRESSES-------			
1	1.	0.	163.	8.8	166.	0.0
2	2.	0.	161.	11.3	170.	0.0
3	3.	0.	159.	7.5	170.	0.0
4	4.	1.	160.	11.3	171.	0.0
5	5.	1.	158.	7.5	171.	0.0
6	7.	1.	158.	10.0	171.	0.0
7	8.	1.	158.	11.3	173.	0.0
8	10.	1.	155.	8.8	170.	0.0
9	11.	1.	155.	10.0	170.	0.0
10	15.	2.	155.	7.5	171.	0.0
11	35.	5.	153.	10.0	170.	0.0
12	37.	5.	150.	23.8	170.	0.0
13	77.	10.	148.	10.0	170.	0.0
14	93.	12.	145.	8.8	173.	0.0
15	140.	19.	143.	7.5	173.	0.0
16	155.	21.	141.	8.8	175.	0.0
17	157.	21.	145.	7.5	170.	0.0
18	163.	22.	145.	12.5	179.	0.0
19	164.	22.	141.	8.8	179.	0.0
20	220.	29.	140.	10.0	175.	0.0
21	230.	31.	140.	5.0	173.	0.0
22	352.	47.	139.	8.8	173.	0.0
23	353.	47.	138.	6.3	173.	0.0
24	373.	50.	135.	7.5	175.	0.0
25	560.	75.	135.	13.8	176.	0.0
26	561.	75.	131.	10.0	178.	0.0
27	565.	76.	128.	7.5	185.	0.0
28	568.	76.	131.	1.3	180.	0.0
29	569.	76.	135.	2.5	175.	0.0
30	570.	76.	140.	3.8	170.	0.0
31	571.	76.	143.	7.5	170.	0.0
32	575.	77.	140.	7.5	171.	0.0
33	578.	77.	138.	15.0		0.0
34	579.	77.	133.	10.0		0.0
35	580.	78.	130.	7.5		0.0
36	605.	81.	138.	10.0	175.	0.0
37	690.	92.	135.	6.3	173.	0.0
38	710.	95.	130.	10.0	175.	0.0
39	715.	96.	135.	6.3	170.	0.0
40	725.	97.	134.	12.5	176.	0.0
41	730.	98.	131.	5.0	174.	0.0
42	741.	99.	130.	7.5	173.	0.0
43	745.	100.	128.	7.5	170.	0.0
44	748.	100.	128.	10.0	175.	0.0

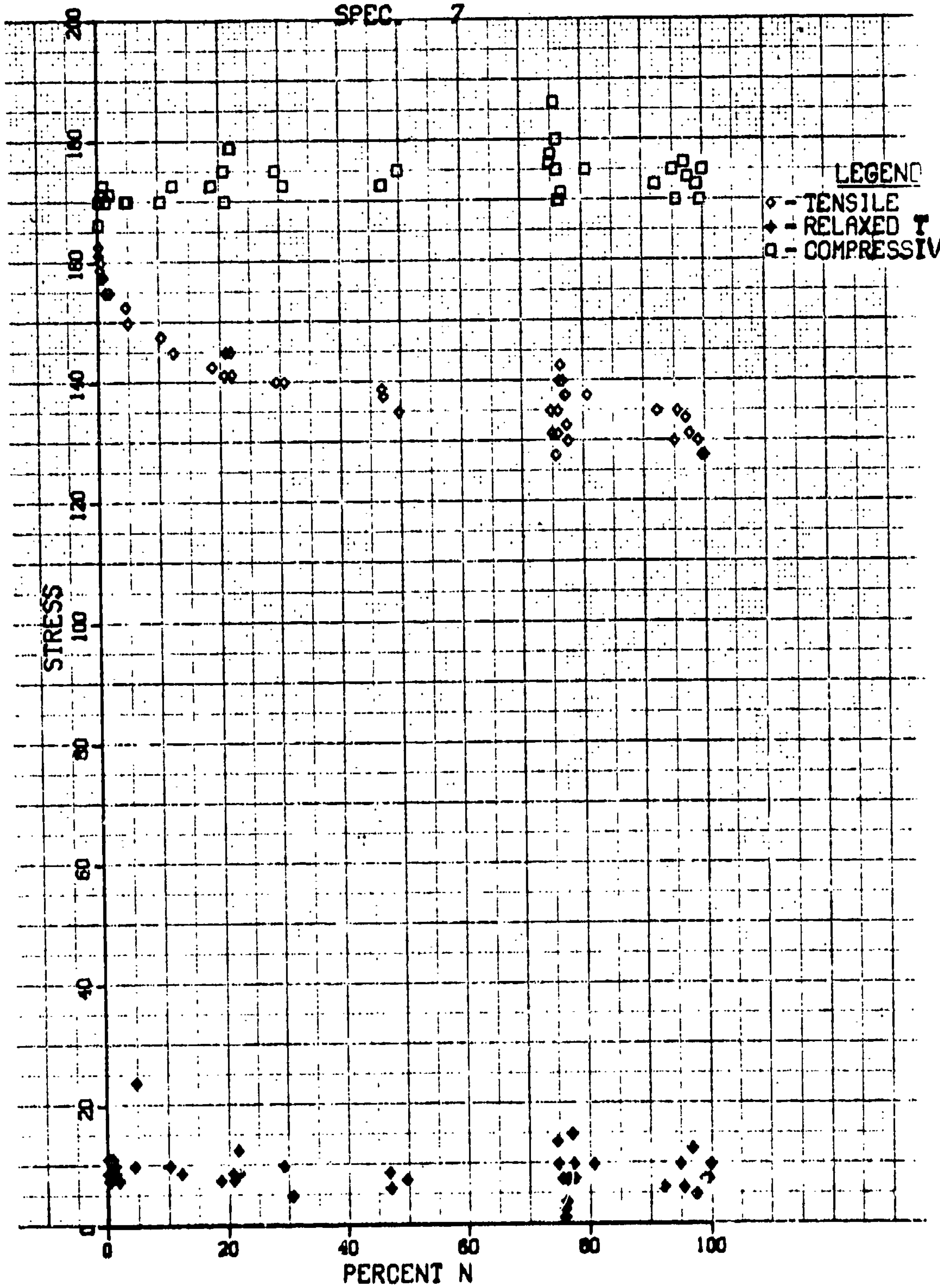

SPEC. 7
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPRESSIVE
STRESS
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
PERCENT N

Figure 36.

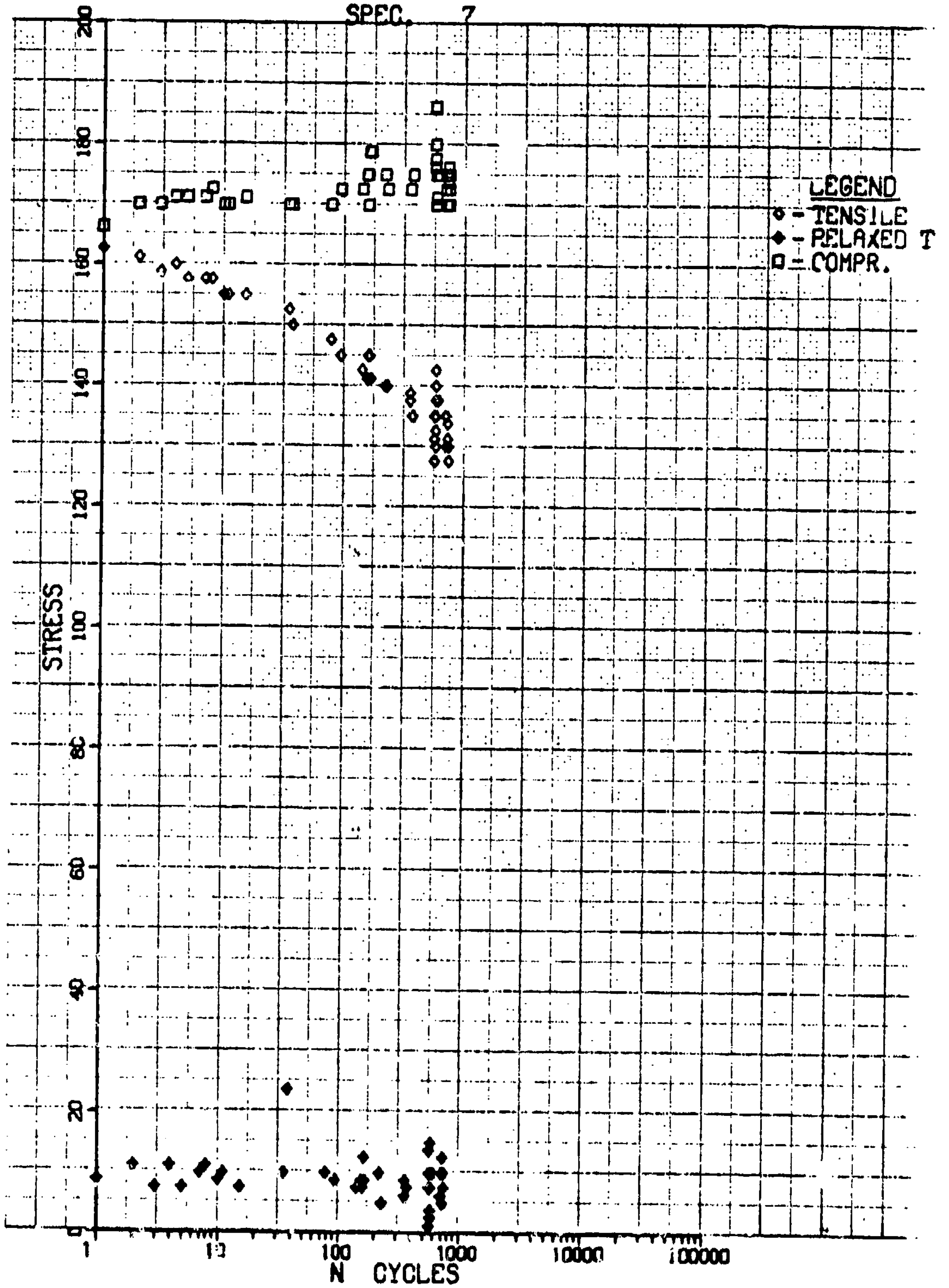

SPEC. 7
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
STRESS
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
100000
N CYCLES

Figure 37.

TABLE 26

SPECIMEN 12

I	N	%N	TENSILE (STRESSES)	RELAXED (STRESSES)	COMPR. (STRESSES)	RELAXED (STRESSES)
1	1.	0.	151.	1.3	143.	0.0
2	2.	0.	150.	0.0	155.	0.0
3	3.	0.	151.	1.3	156.	0.0
4	5.	0.	150.	2.5	156.	0.0
5	6.	0.	150.	5.0	160.	0.0
6	12.	1.	146.	1.3	161.	0.0
7	22.	2.	145.	0.0	161.	0.0
8	24.	2.	145.	1.3	163.	0.0
9	32.	2.	143.	1.3	164.	0.0
10	51.	4.	141.	1.3	165.	0.0
11	60.	5.	140.	0.0	165.	0.0
12	70.	5.	141.	1.3	164.	0.0
13	80.	6.	140.	0.0	165.	0.0
14	99.	8.	140.	1.3	165.	0.0
15	117.	9.	139.	1.3	165.	0.0
16	139.	11.	138.	1.3	165.	0.0
17	195.	15.	136.	1.3	166.	0.0
18	252.	20.	135.	1.3	168.	0.0
19	317.	25.	134.	1.3	168.	0.0
20	393.	30.	133.	1.3	168.	0.0
21	441.	34.	131.	1.3	168.	0.0
22	613.	48.	130.	1.3	168.	0.0
23	774.	60.	129.	1.3	168.	0.0
24	852.	66.	128.	1.3	168.	0.0
25	965.	75.	126.	1.3	169.	0.0
26	1015.	79.	125.	1.3	168.	0.0
27	1035.	80.	124.	1.3	170.	0.0
28	1112.	86.	123.	1.3	170.	0.0
29	1190.	92.	121.	1.3	170.	0.0
30	1216.	94.	120.	1.3	170.	0.0
31	1245.	97.	118.	2.5	171.	0.0
32	1254.	97.	115.	2.5	171.	0.0
33	1264.	98.	110.	2.5	171.	0.0
34	1266.	98.	108.	1.3	171.	0.0
35	1273.	99.	105.	3.8	171.	0.0
36	1276.	99.	103.	2.5	171.	0.0
37	1283.	100.	99.	3.8	171.	0.0
38	1284.	100.	98.	2.5	171.	0.0
39	1285.	100.	98.	3.8	171.	0.0
40	1286.	100.	96.			0.0

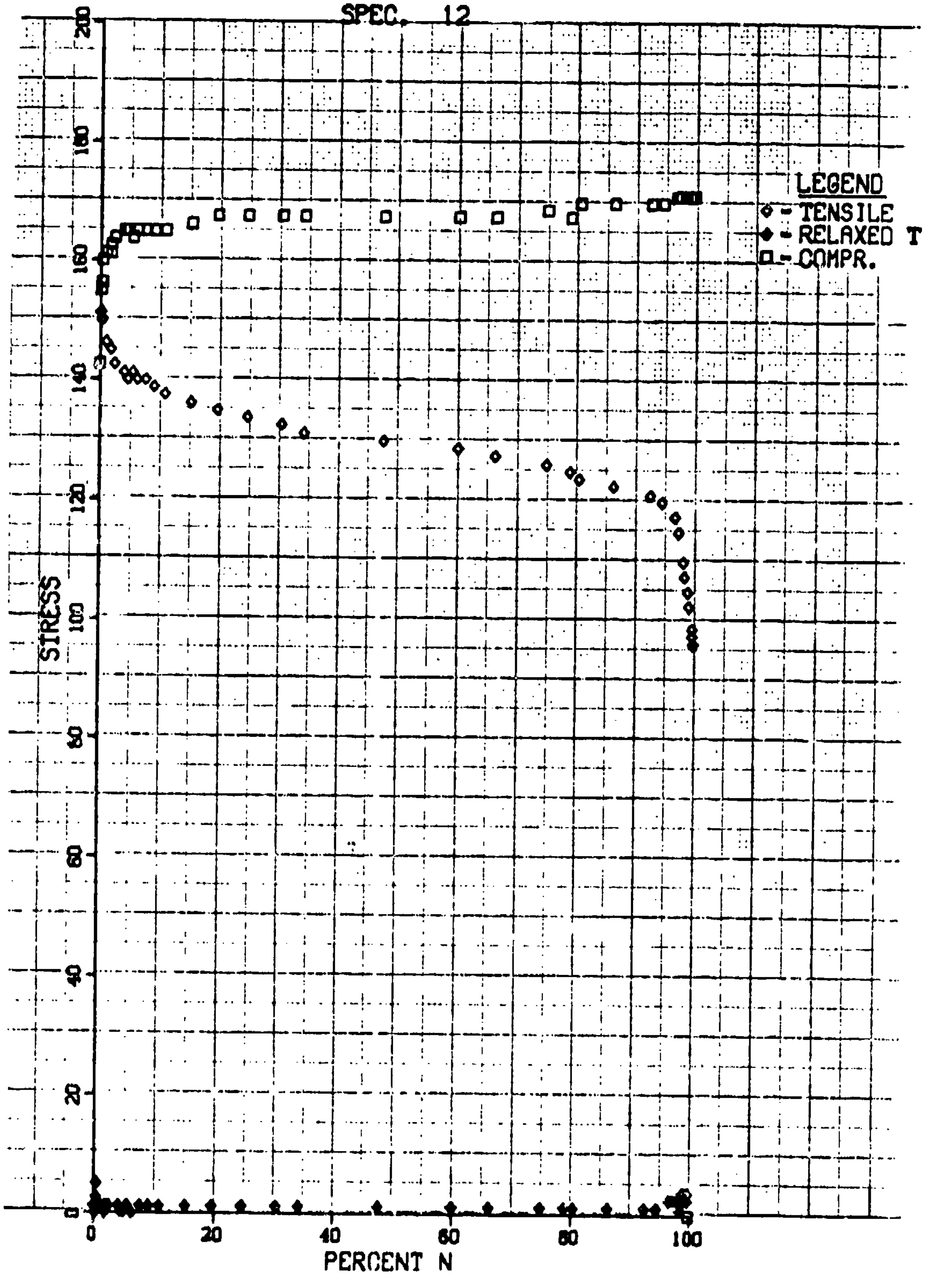

SPEC. 12
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
PERCENT N

Figure 38.

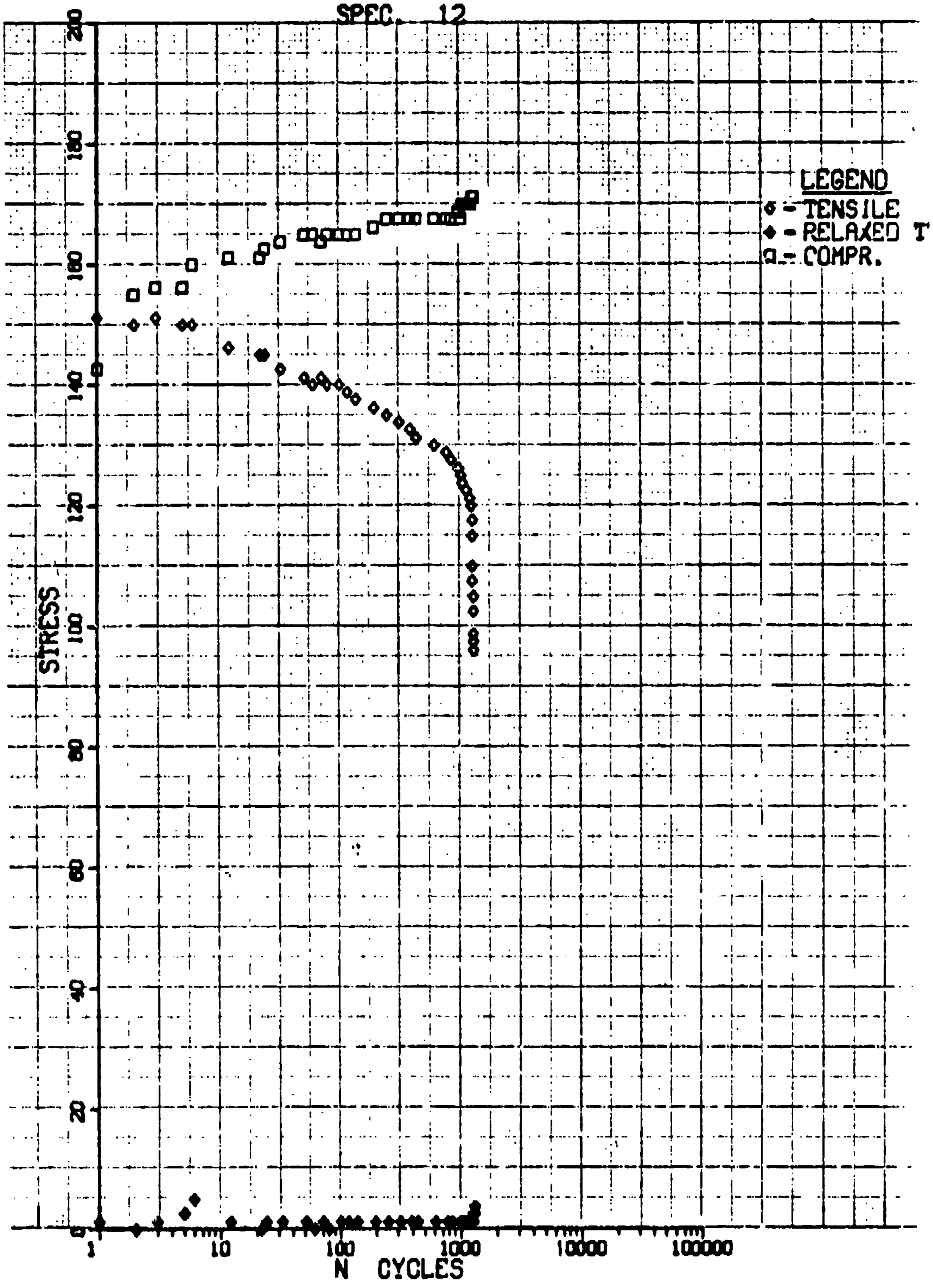
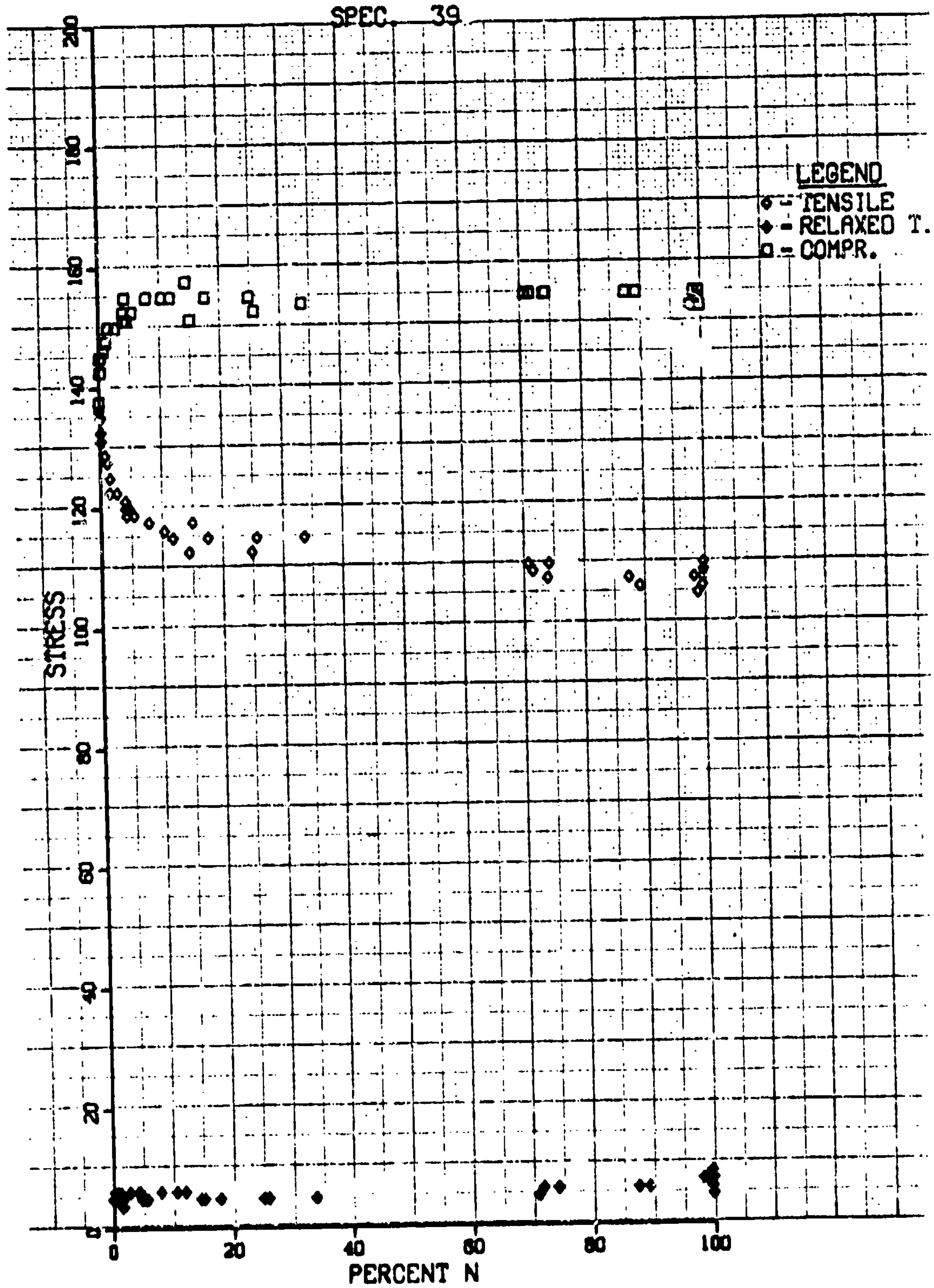

SPEC. 12
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 39.

TABLE 27

SPECIMEN 39

			STRESSES			
I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	136.	5.0	138.	0.0
2	2.	0.	135.	5.0	145.	0.0
3	3.	0.	133.	6.3	143.	0.0
4	4.	0.	131.	5.0	145.	0.0
5	5.	0.	131.	5.0	145.	0.0
6	15.	1.	129.	6.3	146.	0.0
7	20.	1.	128.	6.3	148.	0.0
8	29.	2.	123.	3.8	150.	0.0
9	30.	2.	125.	5.0	150.	0.0
10	49.	3.	123.	6.3	150.	0.0
11	73.	4.	121.	6.3	151.	0.0
12	75.	4.	120.	6.3	153.	0.0
13	77.	4.	119.	6.3	155.	0.0
14	87.	5.	120.	5.0	151.	0.0
15	100.	6.	119.	5.0	153.	0.0
16	144.	8.	118.	6.3	155.	0.0
17	190.	11.	116.	6.3	155.	0.0
18	215.	12.	115.	6.3	155.	0.0
19	261.	15.	113.	5.0	158.	0.0
20	272.	15.	118.	5.0	151.	0.0
21	317.	18.	115.	5.0	155.	0.0
22	444.	25.	113.	5.0	155.	0.0
23	458.	26.	115.	5.0	153.	0.0
24	503.	34.	115.	5.0	154.	0.0
25	1259.	71.	110.	5.0	155.	0.0
26	1275.	72.	109.	6.3	155.	0.0
27	1317.	74.	108.	6.3	155.	0.0
28	1320.	74.	110.	6.3	155.	0.0
29	1558.	87.	108.	6.3	155.	0.0
30	1589.	89.	106.	6.3	155.	0.0
31	1750.	98.	108.	7.5	153.	0.0
32	1759.	99.	105.	7.5	155.	0.0
33	1773.	100.	106.	6.3	155.	0.0
34	1774.	100.	108.	8.8	155.	0.0
35	1775.	100.	108.	7.5	154.	0.0
36	1776.	100.	109.	7.5	153.	0.0
37	1777.	100.	110.	8.8	155.	0.0
38	1778.	100.	110.	5.0	153.	0.0



SPEC. 39
LEGEND
◇ - TENSILE
◆ - RELAXED T.
□ - COMPR.
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 40.

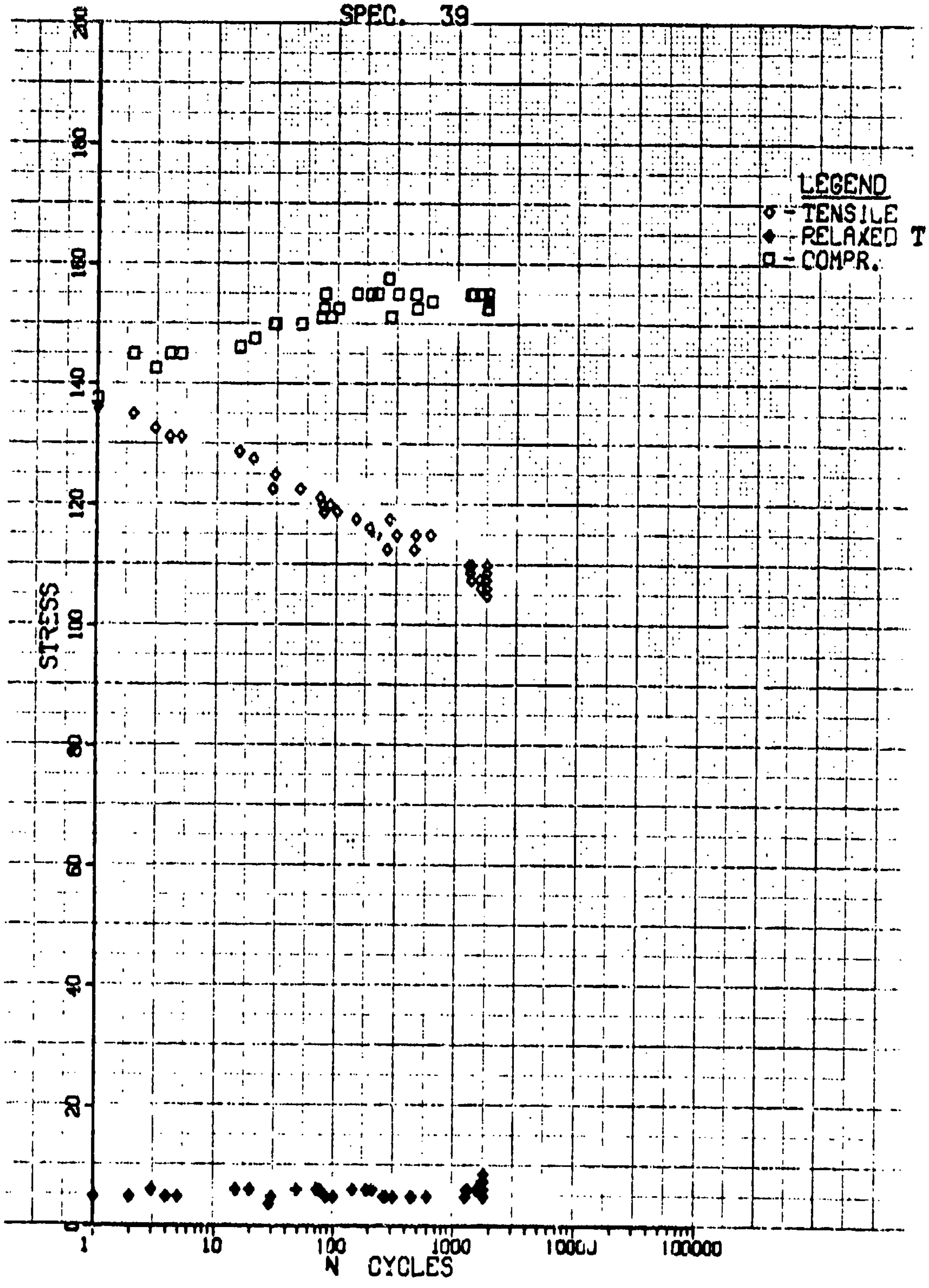

SPEC. 39
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 41.

TABLE 28

SPECIMEN 38

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	163.	2.5	158.	0.0
2	2.	0.	161.	2.5	164.	0.0
3	3.	0.	160.	2.5	165.	0.0
4	4.	0.	159.	1.3	164.	0.0
5	5.	0.	159.	1.3	165.	0.0
6	10.	0.	158.	2.5	166.	0.0
7	12.	0.	156.	2.5	168.	0.0
8	21.	0.	155.	2.5	169.	0.0
9	29.	1.	151.	2.5	171.	0.0
10	31.	1.	153.	2.5	170.	0.0
11	38.	1.	151.	2.5	170.	0.0
12	48.	1.	150.	1.3	171.	0.0
13	58.	1.	149.	2.5	173.	0.0
14	59.	1.	149.	1.3	173.	0.0
15	60.	1.	150.	2.5	173.	0.0
16	86.	2.	148.	3.8	175.	0.0
17	96.	2.	146.	1.3	175.	0.0
18	105.	2.	145.	1.3	175.	0.0
19	115.	2.	143.	1.3	178.	0.0
20	124.	2.	141.	1.3	178.	0.0
21	161.	3.	141.	1.3	180.	0.0
22	162.	3.	143.	2.5	178.	0.0
23	201.	4.	141.	2.5	181.	0.0
24	211.	4.	140.	1.3	18[illegible].	0.0
25	344.	7.	139.	1.3	183.	0.0
26	385.	8.	138.	1.3	181.	0.0
27	400.	8.	138.	2.5	181.	0.0
28	497.	10.	140.	2.5	181.	0.0
29	506.	10.	139.	1.3	151.	0.0
30	600.	12.	136.	1.3	183.	0.0
31	707.	14.	135.	1.3	183.	0.0
32	753.	15.	136.	1.3	181.	0.0
33	868.	17.	135.	1.3	184.	0.0
34	915.	18.	134.	1.3	184.	0.0
35	945.	19.	133.	1.3	185.	0.0
36	1002.	20.	135.	2.5	184.	0.0
37	1087.	22.	136.	2.5	183.	0.0
38	1107.	22.	135.	2.5	183.	0.0
39	1143.	23.	133.	1.3	184.	0.0
40	1353.	27.	130.	2.5	185.	0.0
41	1381.	28.	129.	2.5	188.	0.0
42	1392.	28.	128.	2.5	186.	0.0
43	1508.	30.	129.	2.5	186.	0.0
44	1515.	30.	128.	2.5	188.	0.0
45	1716.	34.	126.	1.3	185.	0.0

Table continued on following page.

TABLE 28 Continued

SPECIMEN 38

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			---------STRESSES-------			
46	1736.	35.	125.	2.5	185.	0.0
47	1751.	35.	129.	2.5	186.	0.0
48	1800.	36.	130.	2.5	185.	0.0
49	2290.	46.	128.	2.5		0.0
50	2534.	51.	125.	5.0	188.	0.0
51	2600.	52.	124.	3.8	189.	0.0
52	2915.	58.	126.	2.5	190.	0.0
53	3503.	72.	123.	2.5	188.	0.0
54	3700.	74.	124.	2.5	188.	0.0
55	3750.	75.	125.	2.5	186.	0.0
56	4109.	82.	121.	2.5	188.	0.0
57	4185.	83.	120.	2.5	189.	0.0
58	4300.	86.	124.	3.8	188.	0.0
59	4504.	92.	123.	2.5	185.	0.0
60	4623.	92.	120.	2.5	186.	0.0
61	4699.	94.	119.	2.5	186.	0.0
62	4700.	94.	118.	2.5	186.	0.0
63	4795.	95.	116.	2.5	186.	0.0
64	4823.	96.	115.	2.5	185.	0.0
65	4835.	96.	114.	2.5		0.0
66	4850.	97.	113.	2.5		0.0
67	4865.	97.	111.	1.3		0.0
68	4875.	97.	110.	2.5		0.0
69	4893.	98.	109.	2.5		0.0
70	4900.	98.	108.	2.5	185.	0.0
71	4912.	98.	105.	5.0		0.0
72	4920.	98.	104.	3.8		0.0
73	4940.	99.	100.	1.3		0.0
74	4947.	99.	99.	3.8		0.0
75	4948.	99.	98.	2.5		0.0
76	4950.	99.	96.	1.3		0.0
77	4956.	99.	95.	1.3		0.0
78	4966.	99.	94.	2.5		0.0
79	4968.	99.	93.	1.3		0.0
80	4970.	99.	91.	2.5		0.0
81	4976.	99.	88.	2.5		0.0
82	4979.	99.	86.	2.5		0.0
83	4983.	99.	84.	1.3		0.0
84	4985.	99.	83.	1.3		0.0
85	4997.	100.	81.	1.3		0.0
86	4999.	100.	80.	2.5		0.0
87	5005.	100.	78.	2.5		0.0
88	5007.	100.	76.	2.5		0.0
89	5013.	100.	74.	1.3		0.0
90	5016.	100.	73.	1.3		0.0

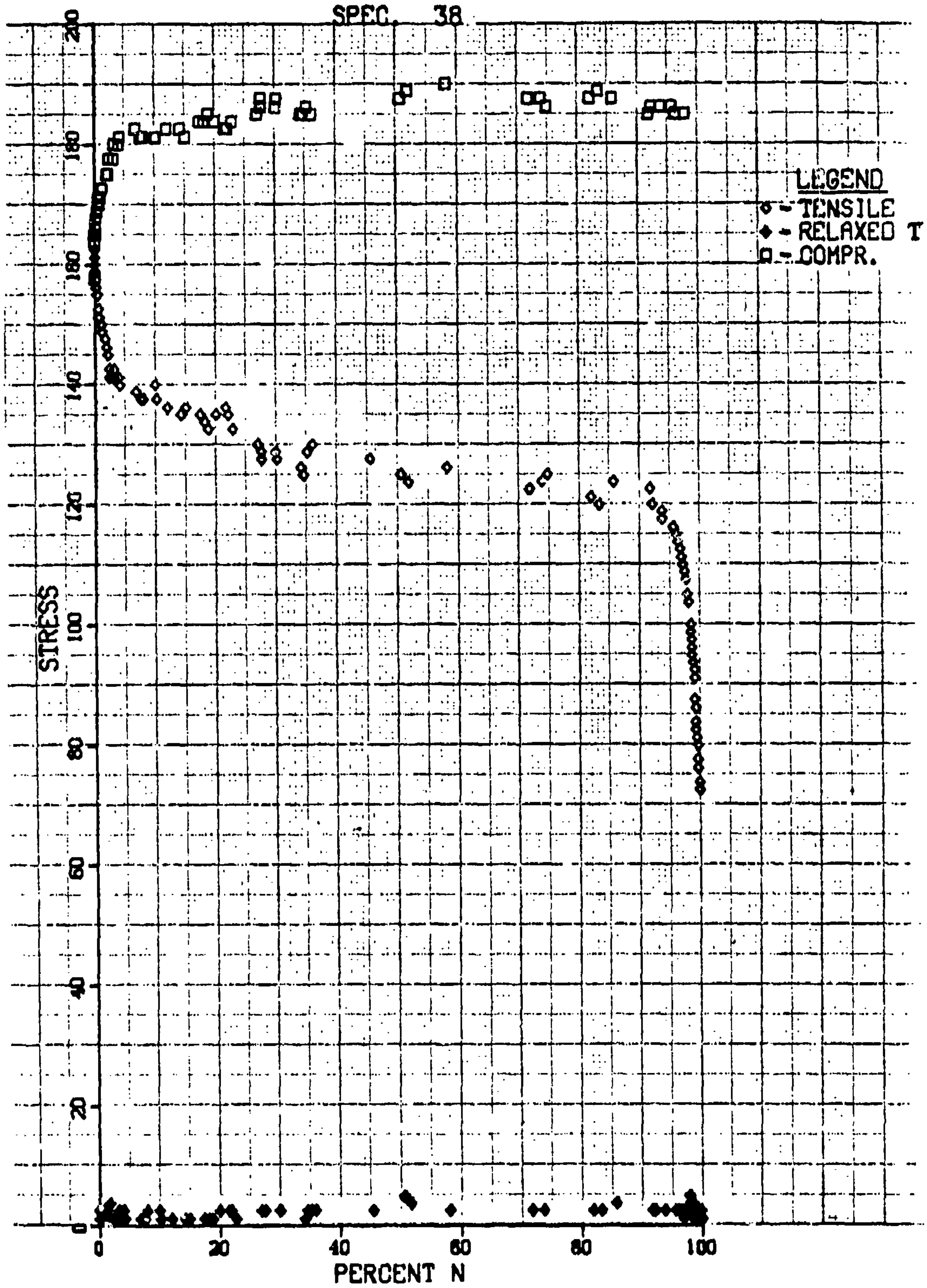

SPEC. 38
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
PERCENT N

Figure 42.

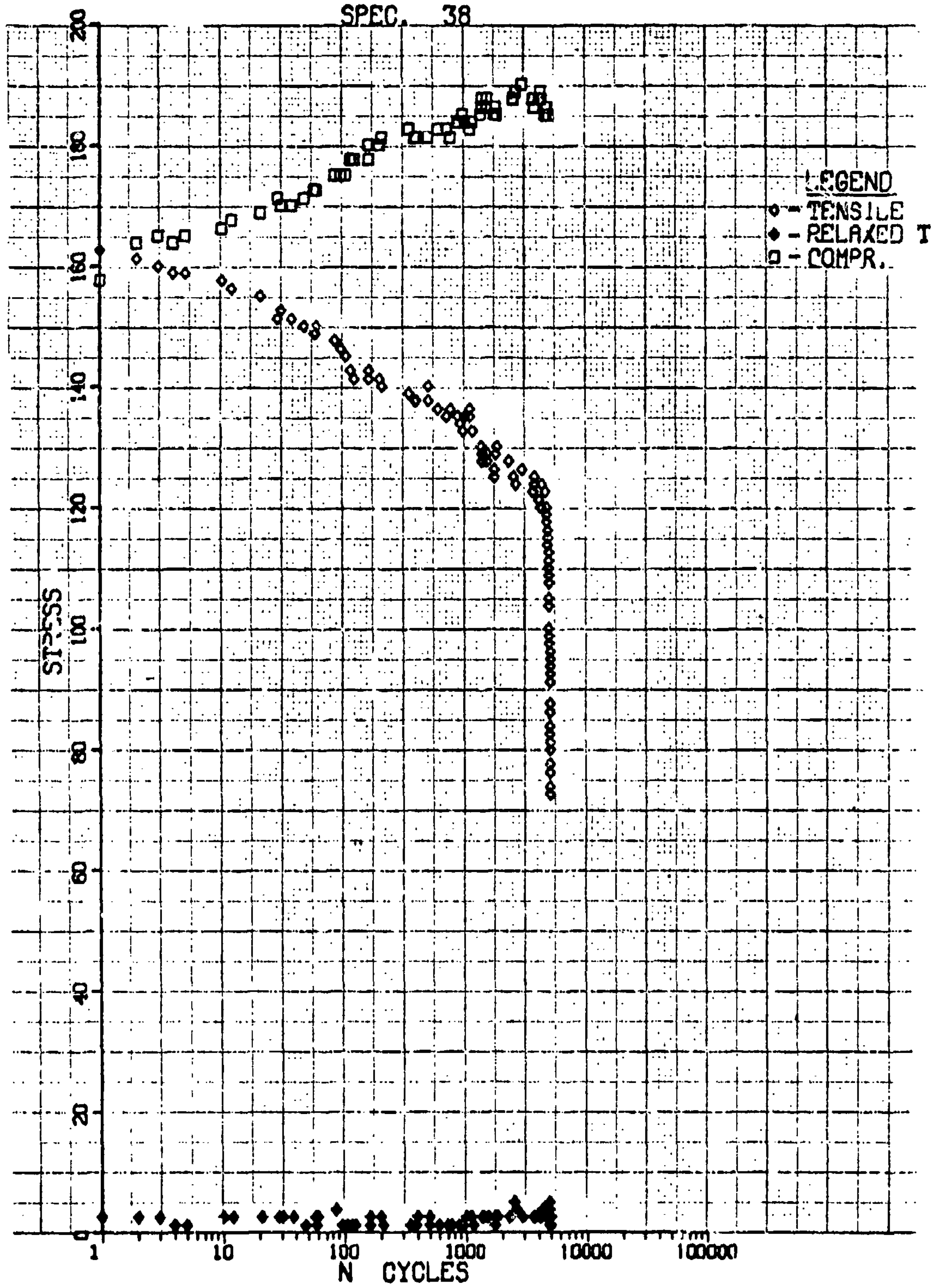

SPEC. 38
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 43.

TABLE 29

SPECIMEN 23J

J	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	125.	3.2	120.	0.0
2	2.	0.	123.	2.0	132.	0.0
3	3.	0.	123.	2.0	131.	0.0
4	4.	0.	122.	2.4	132.	0.0
5	5.	0.	121.	1.2	132.	0.0
6	6.	0.	121.	2.8	132.	0.0
7	7.	0.	120.	.8	131.	0.0
8	8.	0.	120.	1.2	132.	0.0
9	9.	0.	120.	2.0	132.	0.0
10	10.	0.	120.	1.2	132.	0.0
11	16.	0.	115.	2.4	134.	0.0
12	27.	0.	116.	.8	136.	0.0
13	39.	1.	114.	2.0	140.	0.0
14	85.	1.	112.	2.4	141.	0.0
15	96.	1.	110.	2.0	142.	0.0
16	120.	2.	112.	2.0	141.	0.0
17	142.	2.	108.	.8	144.	0.0
18	190.	3.	109.	1.0	143.	0.0
19	200.	3.	107.	1.6	145.	0.0
20	220.	3.	108.	.8	144.	0.0
21	256.	4.	105.	1.2	147.	0.0
22	260.	4.	106.	2.0	144.	0.0
23	314.	5.	104.	.8	148.	0.0
24	339.	5.	105.	.8	146.	0.0
25	375.	6.	104.	2.8	147.	0.0
26	362.	6.	103.	2.0	149.	0.0
27	395.	6.	104.	.8	147.	0.0
28	440.	7.	102.	1.2	148.	0.0
29	453.	7.	104.	2.0	146.	0.0
30	497.	8.	102.	.8	148.	0.0
31	520.	8.	103.	1.6	146.	0.0
32	565.	9.	101.	.8	149.	0.0
33	600.	9.	102.	1.2	148.	0.0
34	645.	10.	100.	2.0	151.	0.0
35	670.	10.	101.	.8	149.	0.0
36	723.	11.	99.	2.0	152.	0.0
37	749.	11.	100.	.4	145.	0.0
38	759.	12.	98.	1.2	152.	0.0
39	774.	12.	97.	.4	152.	0.0
40	782.	12.	100	2.0	152.	0.0
41	795.	12.	95.	1.2	152.	0.0
42	840.	13.	96.	1.6	152.	0.0
43	896.	14.	97.	1.2	152.	0.0
44	940.	14.	97.	.8	152.	0.0
45	965.	15.	96.	.4	153.	0.0
46	988.	15.	95.	1.2	152.	0.0
47	1010.	15.	96.	.8	153.	0.0
48	1034.	16.	98.	1.2	152.	0.0
49	1055.	16.	96.	1.0	153.	0.0
50	1100.	17.	97.	.8	152.	0.0
51	1146.	18.	95.	.8	152.	0.0
52	1160.	18.	96.	1.2	153.	0.0
53	1215.	19.	96.	1.6	153.	0.0
54	1295.	20.	96.	1.8	153.	0.0
55	1340.	21.	95.	1.4	153.	0.0
56	1420.	22.	95.	1.2	154.	0.0
57	1500.	23.	94.	1.2	154.	0.0
58	1604.	25.	94.	1.2	155.	0.0

Table continued on following page.

TABLE 29 Continued

SPECIMEN 233

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
59	1594.	26.	93.	.8	156.	0.0
60	1796.	28.	93.	1.2	156.	0.0
61	1900.	29.	92.	1.0	156.	0.0
62	2030.	31.	92.	.6	156.	0.0
63	2104.	32.	93.	1.2	156.	0.0
64	2140.	33.	92.	1.6	157.	0.0
65	2165.	33.	93.	.6	156.	0.0
66	2275.	35.	92.	1.2	156.	0.0
67	2410.	37.	92.	1.2	156.	0.0
68	2480.	38.	91.	1.2	157.	0.0
69	2700.	41.	89.	.8	155.	0.0
70	2803.	43.	91.	2.0	156.	0.0
71	2824.	43.	89.	1.2	159.	0.0
72	2960.	45.	90.	2.0	158.	0.0
73	3020.	46.	88.	.8	159.	0.0
74	3417.	52.	87.	1.6	160.	0.0
75	3440.	53.	86.	.4	159.	0.0
76	3465.	53.	87.	1.8	160.	0.0
77	3540.	54.	89.	1.4	160.	0.0
78	3804.	58.	86.	1.6	160.	0.0
79	4148.	64.	86.	1.6	160.	0.0
80	4454.	66.	85.	1.2	160.	0.0
81	4732.	73.	86.	1.2	160.	0.0
82	5055.	77.	84.	.4	160.	0.0
83	5400.	83.	84.	1.6	161.	0.0
84	5650.	87.	84.	.6	161.	0.0
85	5800.	89.	86.	1.6	160.	0.0
86	6107.	93.	85.	1.2	160.	0.0
87	6260.	96.	84.	2.0	160.	0.0
88	6349.	97.	82.	1.6	160.	0.0
89	6393.	98.	80.	.4	161.	0.0
90	6440.	99.	79.	2.6	160.	0.0
91	6450.	99.	77.	1.2	160.	0.0
92	6473.	99.	73.	1.2	160.	0.0
93	6484.	99.	71.	2.0	160.	0.0
94	6496.	99.	68.	2.4	160.	0.0
95	6507.	100.	64.	2.0	160.	0.0
96	6517.	100.	61.	1.0	160.	0.0
97	6530.	100.	60.	2.4	159.	0.0

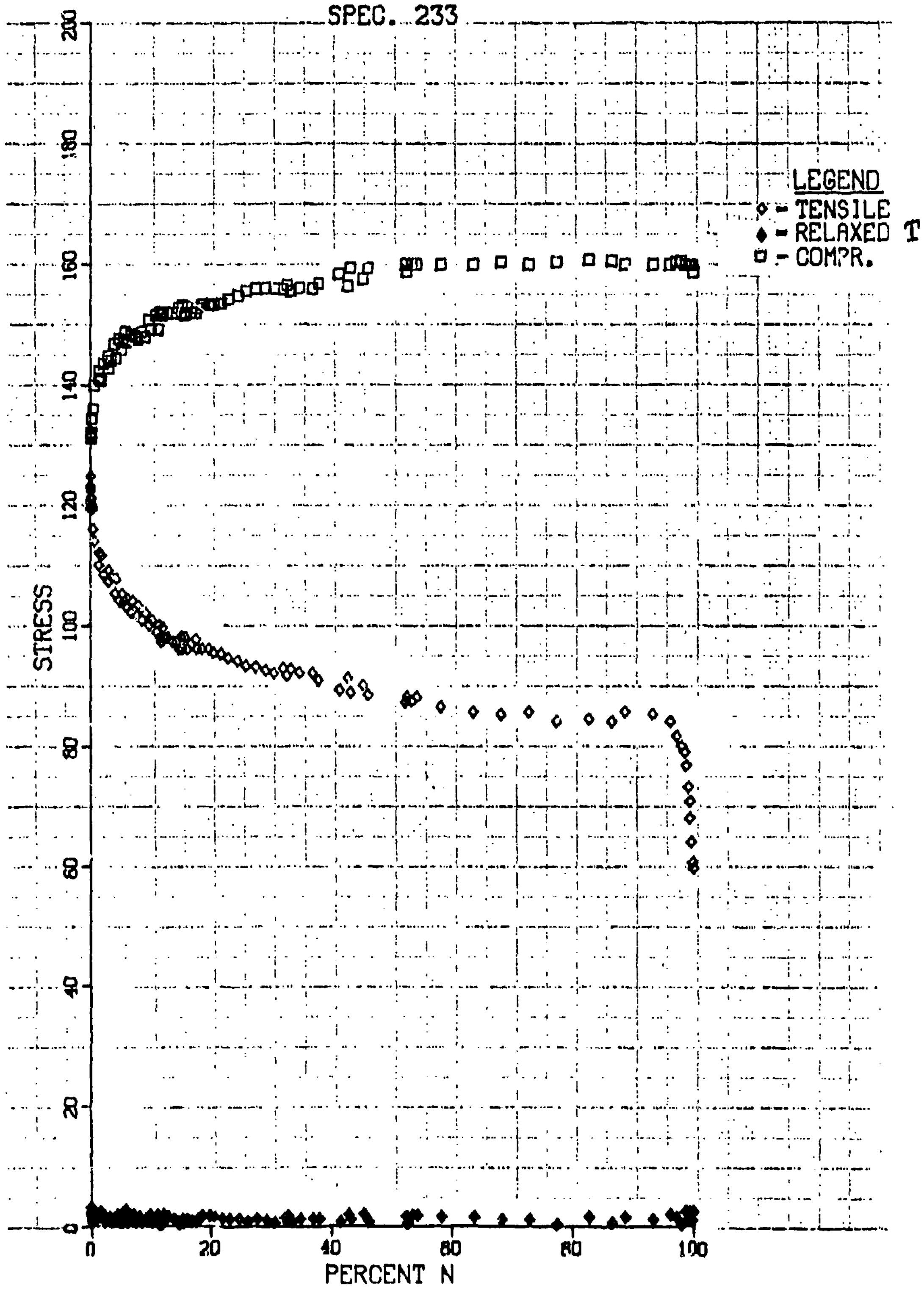
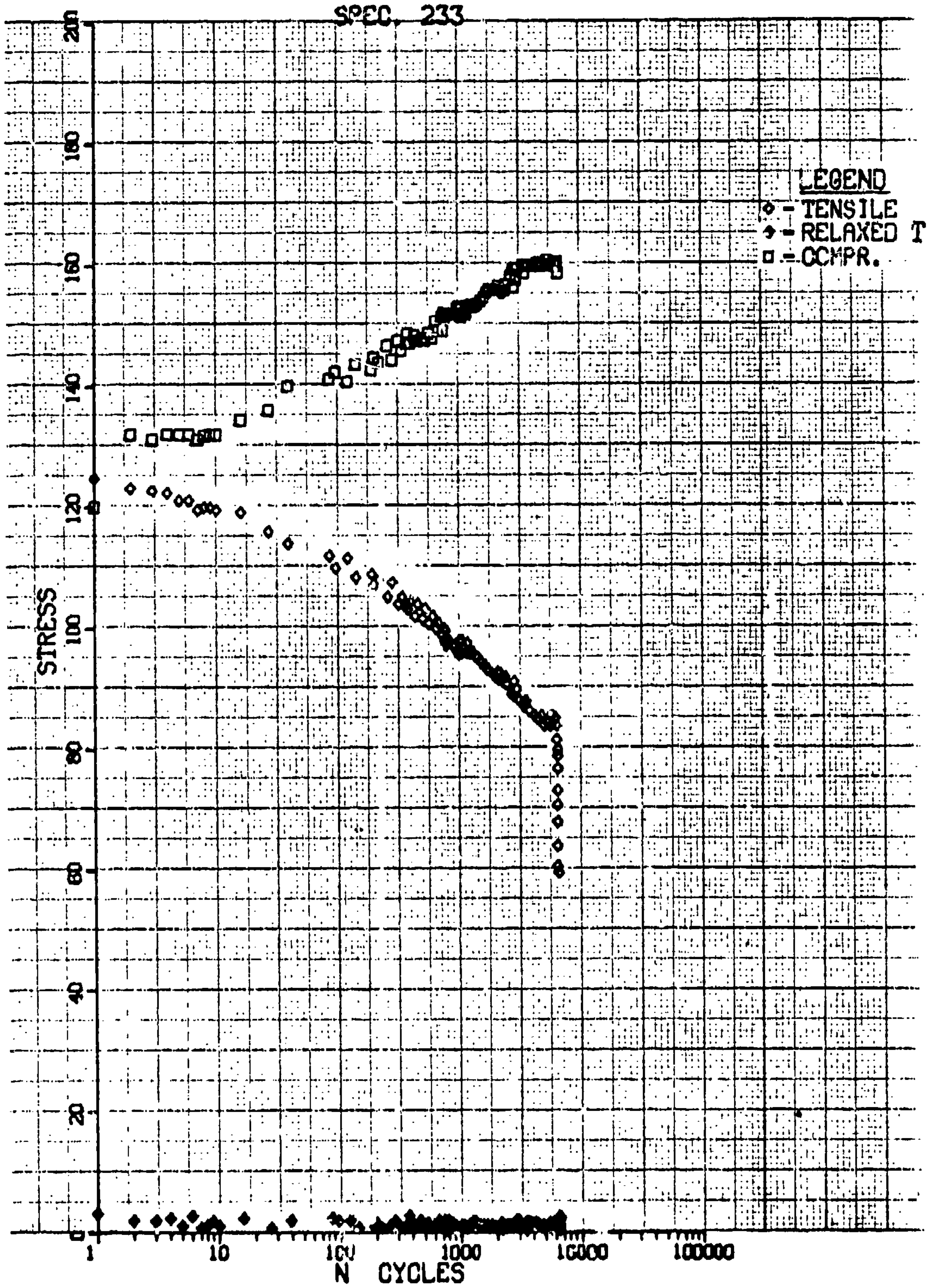

SPEC. 233
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N

Figure 44.



SPEC. 233
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 45.

TABLE 30

SPECIMEN 13

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	121.	-1.3	125.	0.0
2	2.	0.	123.		139.	0.0
3	3.	0.		0.0	134.	0.0
4	4.	0.			134.	0.0
5	12.	0.	114.	0.0		0.0
6	16.	0.		0.0	136.	0.0
7	17.	0.		0.0	138.	0.0
8	26.	0.	113.	0.0	138.	0.0
9	28.	0.	113.	0.0		0.0
10	40.	0.	110.	0.0	140.	0.0
11	74.	1.	109.	0.0	141.	0.0
12	84.	1.	105.	0.0	143.	0.0
13	113.	1.	105.	0.0	144.	0.0
14	126.	1.	105.	0.0	145.	0.0
15	170.	2.	104.	0.0	145.	0.0
16	226.	2.	103.	0.0		0.0
17	300.	3.	100.	0.0		0.0
18	400.	4.	99.	0.0		0.0
19	453.	5.	98.	0.0		0.0
20	565.	6.	96.	0.0		0.0
21	597.	7.	95.	0.0		0.0
22	913.	10.	94.	0.0		0.0
23	1002.	10.	93.	0.0		0.0
24	1100.	11.	91.	0.0		0.0
25	1135.	12.	95.	0.0	151.	0.0
26	1150.	12.	94.	0.0	151.	0.0
27	1264.	13.	93.	0.0	153.	0.0
28	1350.	14.	91.	0.0	153.	0.0
29	1500.	16.	90.	0.0	154.	0.0
30	1600.	17.	90.	0.0	155.	0.0
31	2059.	22.	89.	0.0	155.	0.0
32	2383.	25.	88.	0.0	156.	0.0
33	2500.	27.	85.	0.0	155.	0.0
34	2800.	29.	85.	0.0	158.	0.0
35	4000.	42.	84.	0.0	158.	0.0
36	4375.	46.	84.	0.0	159.	0.0
37	4398.	46.	83.	0.0	159.	0.0
38	4800.	50.	83.	0.0	159.	0.0
39	5070.	53.	81.	0.0	160.	0.0
40	6000.	62.	80.	0.0	160.	0.0
41	6229.	65.	79.	0.0	161.	0.0
42	6300.	66.	80.	0.0	160.	0.0
43	6385.	66.	79.	0.0	161.	0.0
44	6450.	67.	79.	0.0	160.	0.0
45	6500.	68.	79.	0.0	161.	0.0
46	6515.	68.	80.	0.0	160.	0.0
47	6690.	70.	79.	0.0	161.	0.0
48	6714.	70.	79.	0.0	161.	0.0
49	6804.	71.	80.	0.0	160.	0.0
50	7003.	73.	79.	0.0	160.	0.0
51	7433.	77.	78.	0.0	161.	0.0
52	7503.	78.	79.	0.0	160.	0.0
53	7586.	79.	78.	0.0	161.	0.0
54	7890.	82.	80.	0.0	163.	0.0
55	7900.	82.	81.	0.0	161.	0.0
56	7925.	82.	79.	0.0	161.	0.0
57	7960.	83.	80.	0.0	161.	0.0
58	8400.	87.	79.	1.3	161.	0.0
59	8801.	92.	78.	1.3	163.	0.0
60	8900.	93.	79.	1.3	163.	0.0
61	9199.	96.	78.	1.3	163.	0.0
62	9340.	97.	80.	2.5	163.	0.0
63	9450.	98.	81.	1.3	163.	0.0
64	9495.	99.	83.	1.3	163.	0.0
65	9511.	99.	84.	1.3	163.	0.0
66	9517.	99.	85.	2.5	163.	0.0
67	9530.	99.	85.	1.3	164.	0.0
68	9536.	99.	86.	1.3	163.	0.0
69	9540.	99.	89.	2.5	163.	0.0
70	9556.	99.	89.	2.5	164.	0.0
71	9569.	100.	91.	2.5	164.	0.0
72	9574.	100.	91.	2.5	165.	0.0

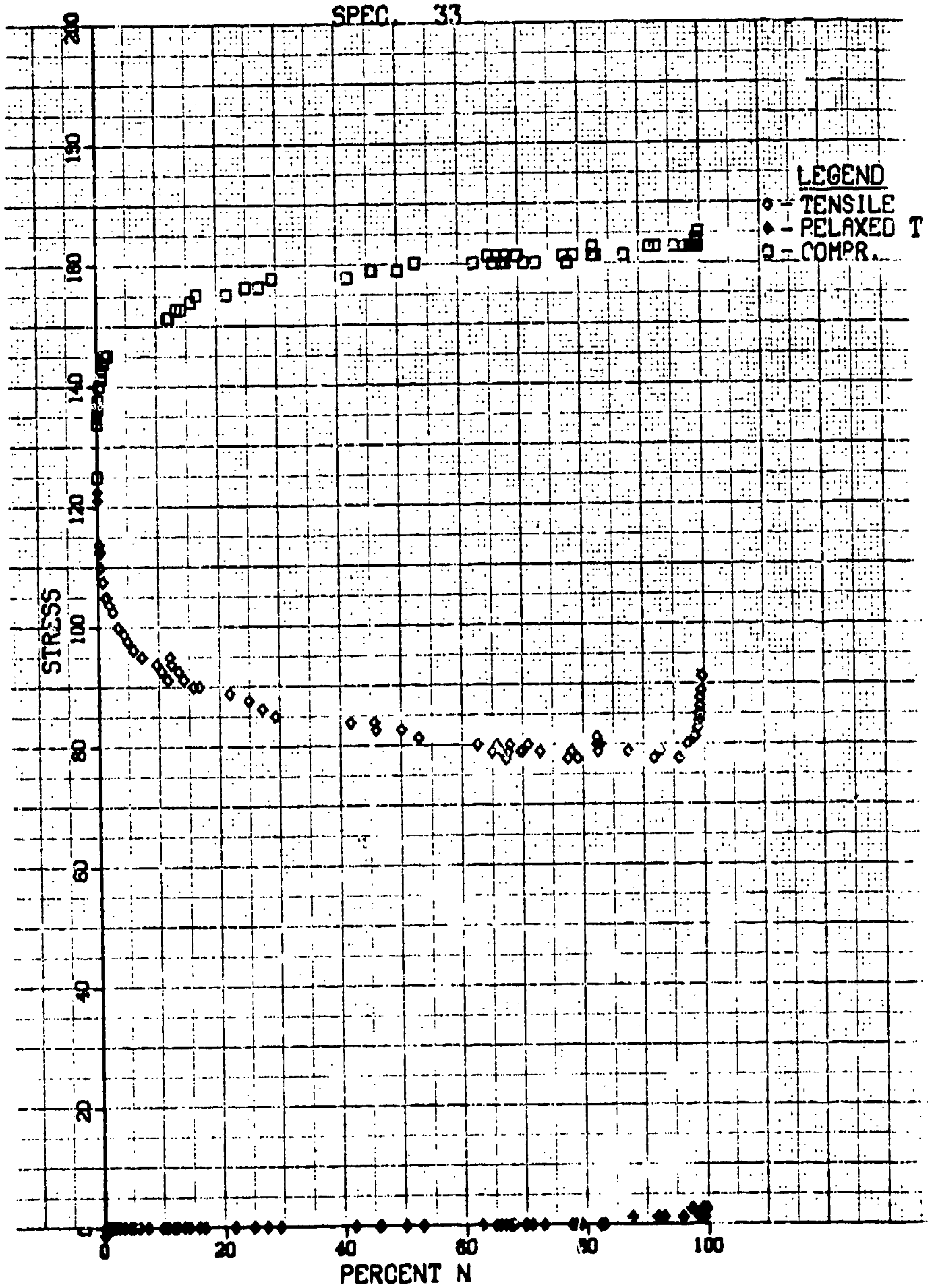

SPEC. 33
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N
0
20
40
60
80
100

Figure 46.

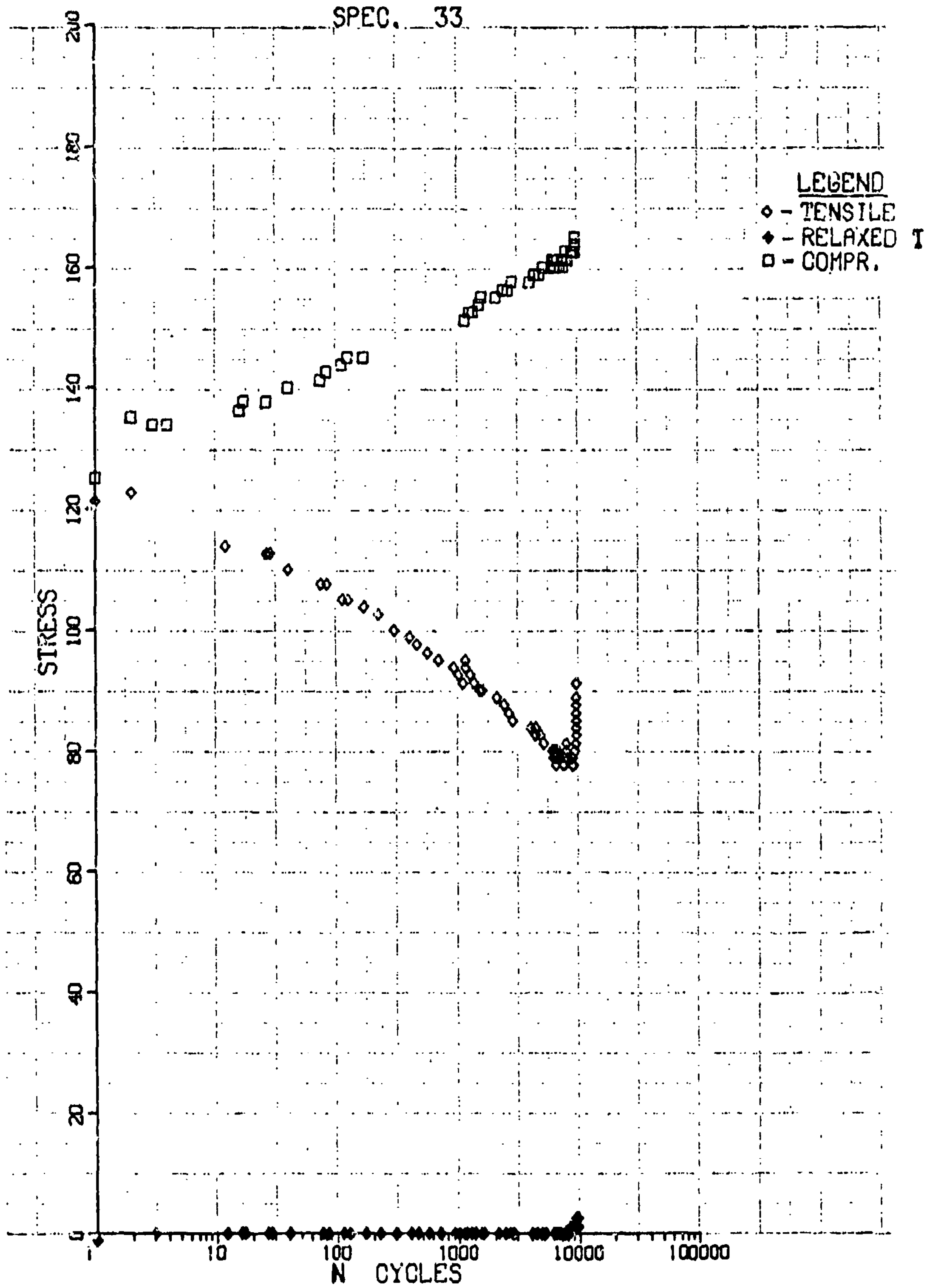


Figure 47.

TABLE 31

SPECIMEN 237

			---------STRESSES-------			
I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
1	1.	.01	114.	2.0	112.	0.0
2	2.	.01	112.	2.0	112.	0.0
3	9.	.05	109.	1.0	116.	0.0
4	10.	.06	109.	2.0	117.	0.0
5	11.	.07	108.	1.0	117.	0.0
6	19.	.12	106.	2.0	119.	0.0
7	20.	.12	106.	2.0	120.	0.0
8	8209.	50.00	74.	2.0	149.	0.0
9	12314.	75.00	70.	1.0	152.	0.0

TABLE 32

SPECIMEN 228

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			--------------------STRESSES	-------	-------	
1	1.	0.	167.	11.0	165.	0.0
2	2.	0.	160.	8.0	177.	0.0
3	3.	1.	160.	8.0	175.	0.0
4	4.	1.	158.	9.0	176.	0.0
5	5.	1.	157.	8.0	177.	0.0
6	10.	2.	153.	7.0	179.	0.0
7	16.	3.	150.	7.0	181.	0.0
8	22.	5.	148.	8.0	182.	0.0
9	28.	6.	146.	8.0	192.	0.0
10	34.	7.	145.	7.0	184.	0.0
11	46.	10.	144.	8.0	184.	0.0
12	52.	11.	142.	7.0	185.	0.0
13	64.	13.	141.	6.0	185.	0.0
14	70.	15.	140.	8.0	186.	0.0
15	81.	17.	139.	6.0	187.	0.0
16	88.	18.	138.	8.0	188.	0.0
17	105.	22.	135.	7.0	189.	0.0
18	111.	23.	136.	10.0	190.	0.0
19	117.	24.	136.	9.0	189.	0.0
20	129.	27.	134.	8.0	190.	0.0
21	153.	32.	132.	9.0	191.	0.0
22	160.	33.	131.	7.0	191.	0.0
23	208.	43.	130.	7.0	190.	0.0
24	213.	44.	131.	9.0	192.	0.0
25	231.	48.	130.	9.0	191.	0.0
26	246.	51.	129.	9.0	192.	0.0
27	248.	52.	132.	9.0	192.	0.0
28	272.	57.	130.	8.0	190.	0.0
29	278.	58.	129.	9.0	192.	0.0
30	284.	59.	128.	8.0	192.	0.0
31	308.	64.	128.	10.0	192.	0.0
32	319.	66.	128.	11.0	192.	0.0
33	326.	68.	127.	9.0	192.	0.0
34	332.	69.	128.	12.0	193.	0.0
35	360.	75.	126.	10.0	192.	0.0
36	372.	77.	125.	9.0	192.	0.0
37	383.	80.	124.	10.0	194.	0.0
38	389.	81.	123.	9.0	193.	0.0
39	395.	82.	124.	10.0	193.	0.0
40	437.	91.	122.	9.0	192.	0.0
41	449.	93.	120.	12.0	192.	0.0
42	455.	95.	116.	12.0	192.	0.0
43	461.	96.	106.	12.0	192.	0.0
44	462.	96.	102.			0.0
45	467.	97.	88.	10.0	193.	0.0
46	468.	97.	84.			0.0
47	473.	99.	63.	11.0	196.	0.0
48	474.	99.	53.			0.0

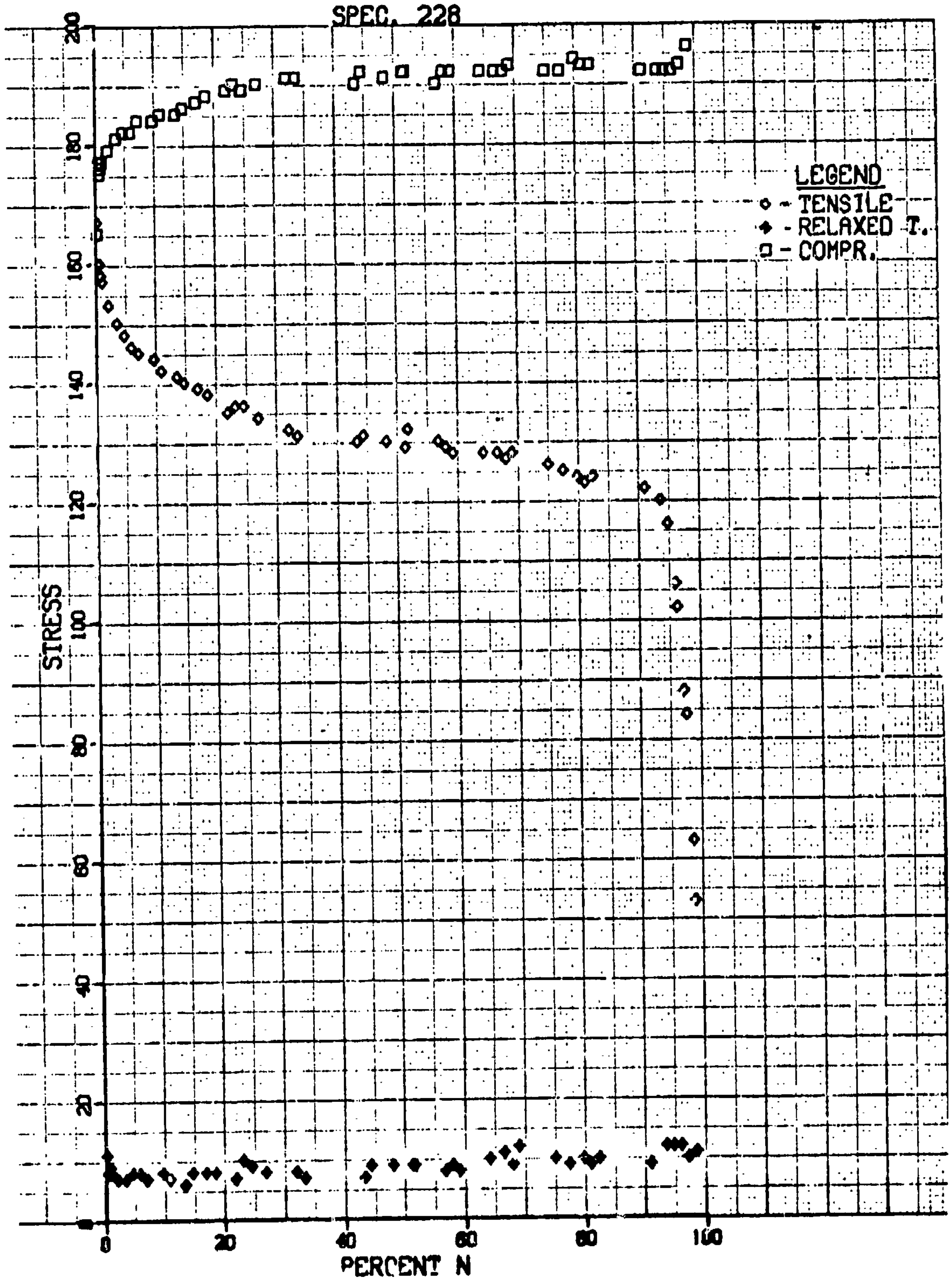

SPEC. 228
LEGEND
◇ - TENSILE
◆ - RELAXED T.
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N

Figure 48.

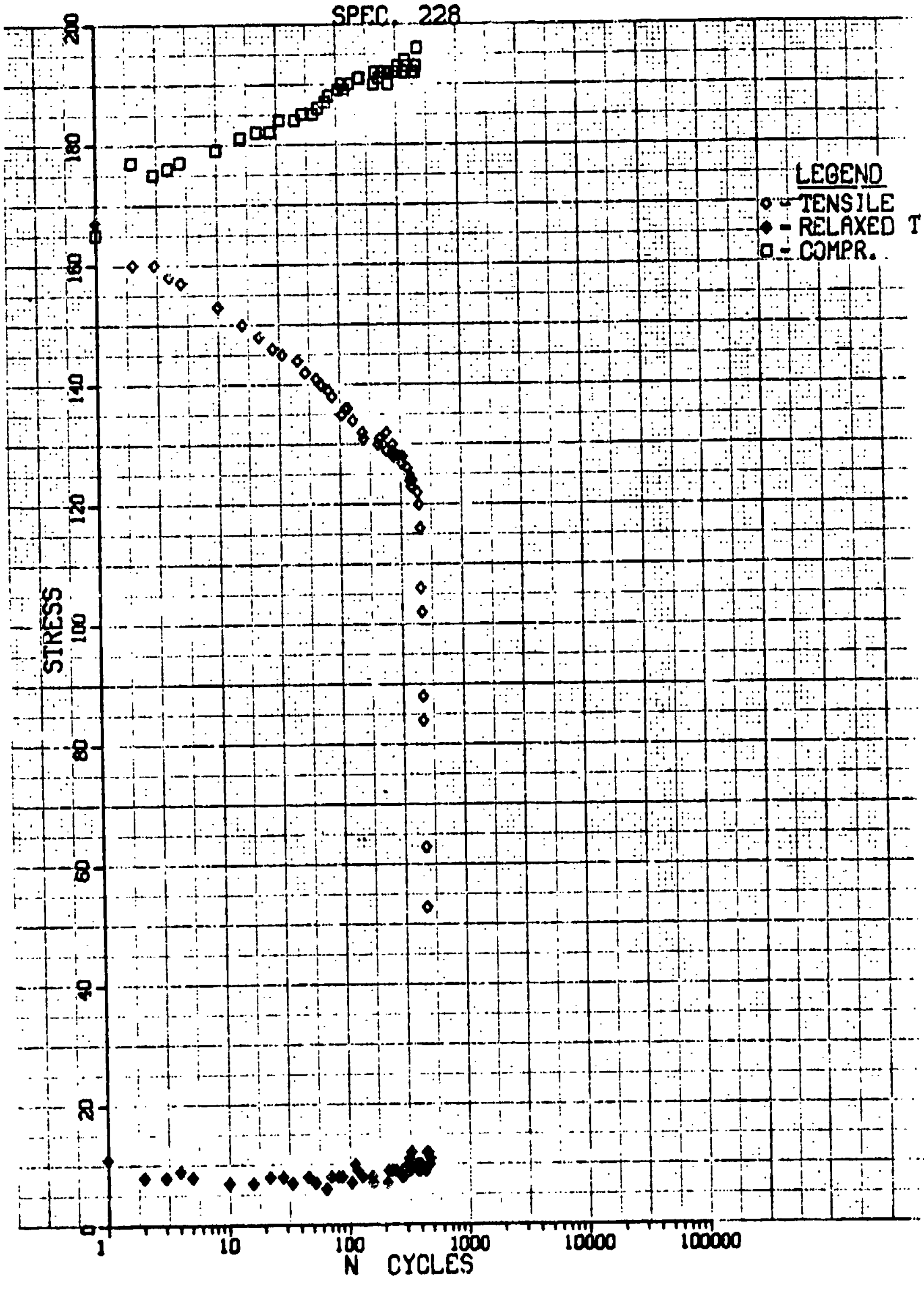

SPEC. 228
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 49.

TABLE 33

SPECIMEN 40

I	N	XN	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	153.	10.0	153.	0.0
2	2.	0.	146.	7.5	163.	0.0
3	3.	0.	145.	10.0	160.	0.0
4	4.	0.	141.	6.3	160.	0.0
5	7.	0.	138.	5.0	163.	0.0
6	10.	1.	136.	5.0	164.	0.0
7	19.	1.	133.	5.0	166.	0.0
8	31.	2.	129.	3.8	168.	0.0
9	43.	3.	126.	5.0	170.	0.0
10	55.	3.	125.	5.0	171.	0.0
11	67.	4.	124.	3.8	173.	0.0
12	71.	4.	123.	5.0	174.	0.0
13	91.	5.	121.	5.0	174.	0.0
14	102.	6.	120.	5.0	175.	0.0
15	114.	7.	124.	8.8	173.	0.0
16	118.	7.	121.	6.3	174.	0.0
17	129.	8.	120.	5.0	171.	0.0
18	137.	8.	121.	6.3	171.	0.0
19	177.	10.	120.	5.0	173.	0.0
20	201.	12.	119.	3.8	173.	0.0
21	213.	12.	119.	6.3	173.	0.0
22	239.	14.	115.	3.8	174.	0.0
23	253.	15.	118.	5.0	174.	0.0
24	287.	17.	116.	5.0	175.	0.0
25	345.	20.	115.	5.0	175.	0.0
26	455.	29.	114.	6.3	176.	0.0
27	525.	31.	113.	5.0	176.	0.0
28	535.	31.	113.	6.3	176.	0.0
29	631.	37.	111.	5.0	178.	0.0
30	643.	38.	111.	6.3	178.	0.0
31	691.	41.	110.	6.3	179.	0.0
32	774.	45.	109.	6.3	179.	0.0
33	812.	48.	108.	6.3	180.	0.0
34	1025.	67.	110.	7.5	176.	0.0
35	1241.	73.	106.	6.3	178.	0.0
36	1256.	74.	106.	6.3	178.	0.0
37	1264.	74.	108.	7.5	178.	0.0
38	1276.	75.	106.	6.3	175.	0.0
39	1396.	82.	105.	6.3	176.	0.0
40	1408.	83.	105.	7.5	178.	0.0
41	1538.	90.	104.	8.8	178.	0.0
42	1575.	92.	105.	10.0	176.	0.0
43	1610.	94.	104.	8.8	176.	0.0
44	1611.	94.	103.	7.5	175.	0.0
45	1650.	97.	101.	3.8	176.	0.0
46	1657.	97.	100.	2.5	178.	0.0
47	1694.	99.	99.	8.8	175.	0.0
48	1701.	100.	95.	10.0	175.	0.0
49	1702.	100.	94.	8.8	175.	0.0
50	1703.	100.	93.	15.0	175.	0.0
51	1704.	100.	85.	10.0	175.	0.0
52	1705.	100.	83.	7.5	174.	0.0
53	1706.	100.	83.			0.0

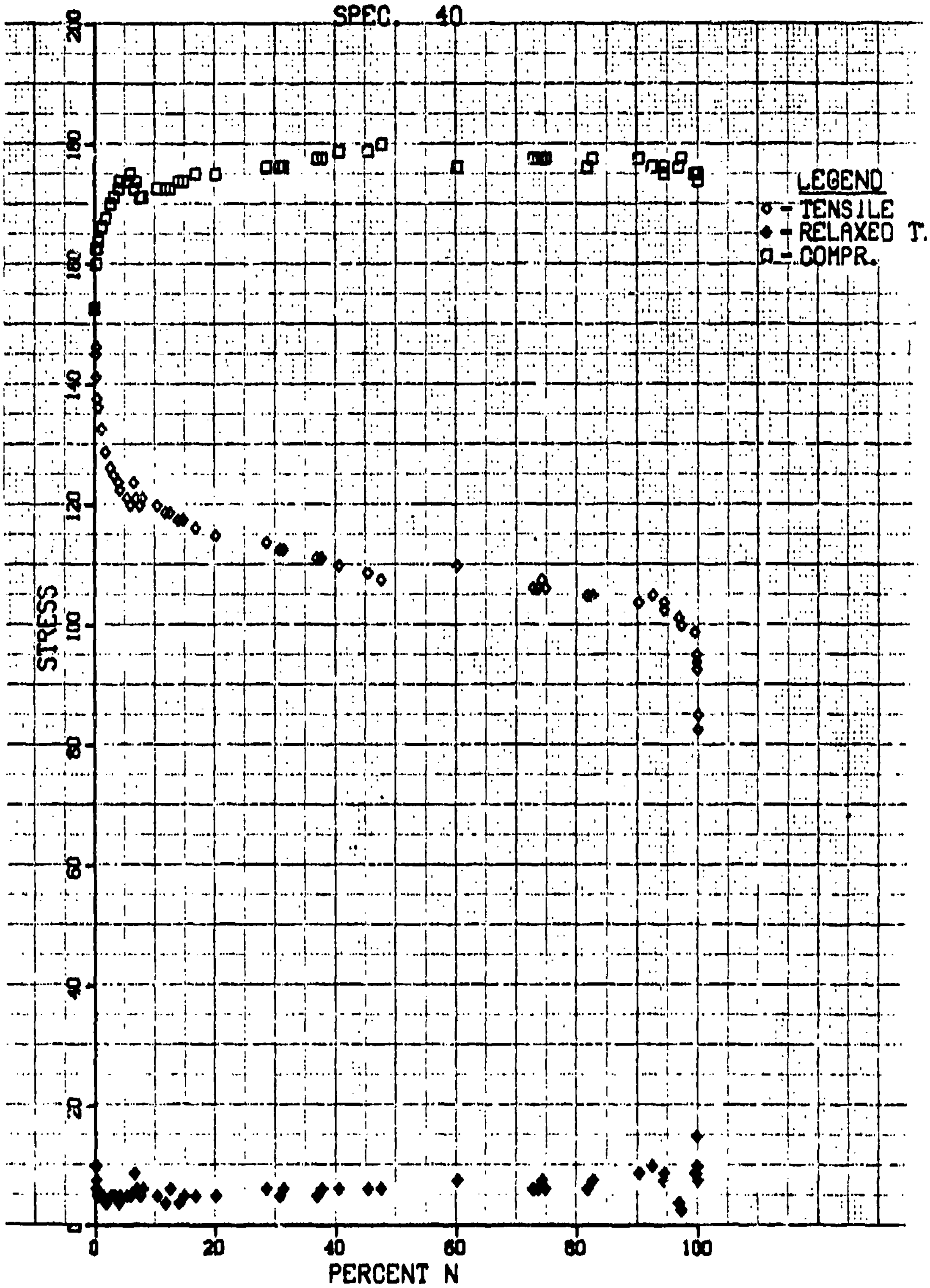

SPEC. 40
LEGEND
◇ - TENSILE
◆ - RELAXED T.
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
PERCENT N

Figure 50.

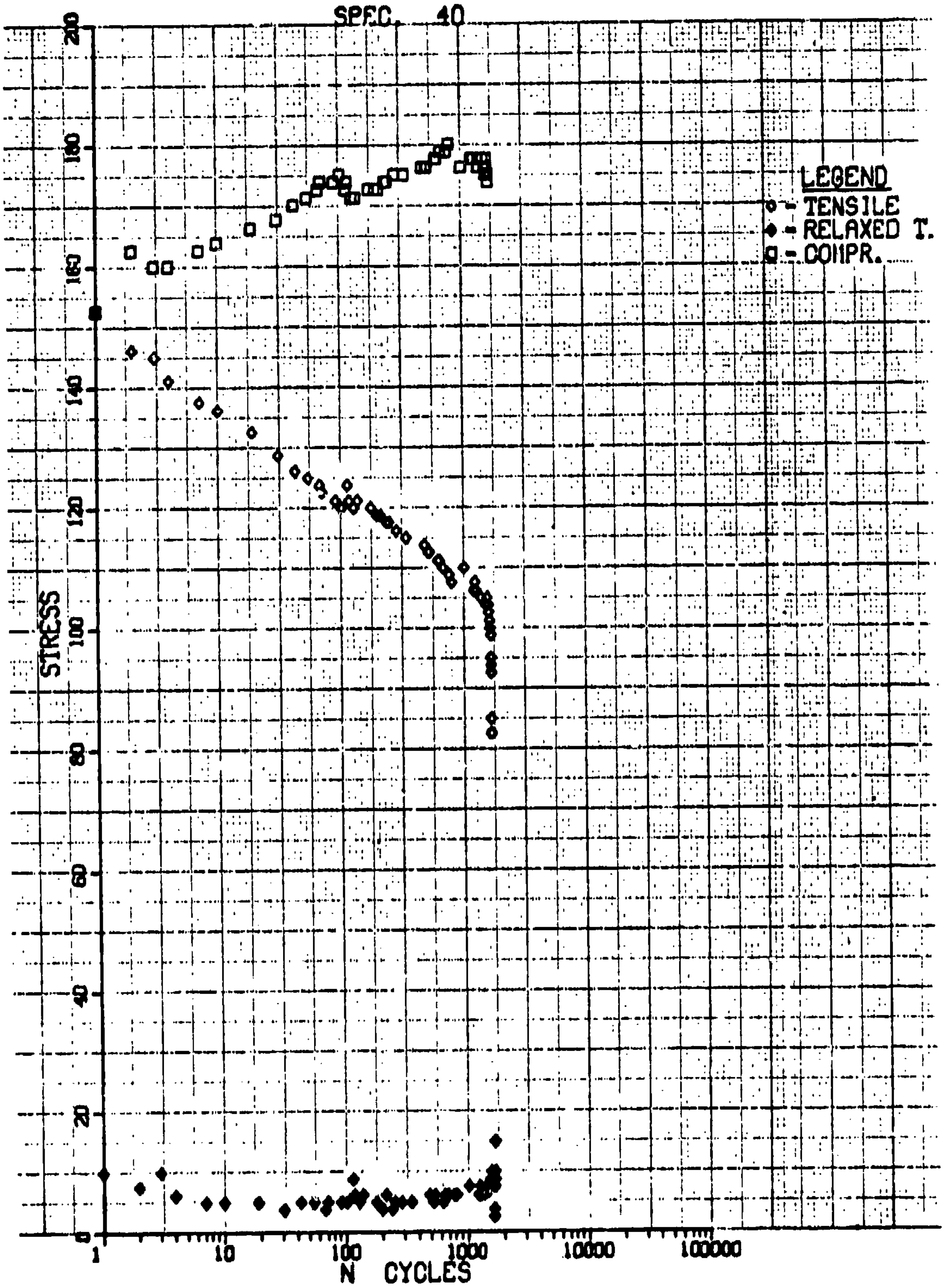

SPEC. 40
LEGEND
TENSILE
RELAXED T.
COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 51.

TABLE 34

SPECIMEN 242

I	N	%N	PEAK TENSILE	HELD TENSILE	RELAXED TENSILE	PEAK COMPR.	HELD COMPR.	RELAXED COMPR.
1	1.	0.	172.	158.	3.0	184.	0.	0.0
2	2.	0.	172.	166.	14.0	184.	0.	0.0
3	3.	1.	172.	166.	14.0	185.	0.	0.0
4	4.	1.	174.	168.	15.0	185.	0.	0.0
5	20.	4.	172.	168.	16.0	183.	0.	0.0
6	31.	7.	172.	168.	17.0	188.	0.	0.0
7	46.	10.	171.	156.	16.0	188.	0.	0.0
8	62.	13.	170.	164.	15.0	183.	0.	0.0
9	77.	16.	169.	163.	15.0	183.	0.	0.0
10	92.	19.	168.	162.	15.0	188.	0.	0.0
11	111.	24.	168.	150.	14.0	188.	0.	0.0
12	123.	26.	167.	160.	15.0	183.	0.	0.0
13	124.	26.	166.	160.	16.0	188.	0.	0.0
14	152.	32.	164.	158.	14.0	188.	0.	0.0
15	209.	44.	164.	156.	13.0	188.	0.	0.0
16	222.	47.	164.	155.	13.0	188.	0.	0.0
17	250.	53.	162.	154.	14.0	188.	0.	0.0
18	270.	57.	162.	154.	14.0	186.	0.	0.0
19	295.	63.	160.	152.	13.0	189.	0.	0.0
20	340.	72.	160.	151.	12.0	185.	0.	0.0
21	384.	81.	157.	150.	14.0	190.	0.	0.0
22	400.	85.	160.	150.	13.0	184.	0.	0.0
23	416.	88.	158.	150.	14.0	184.	0.	0.0
24	430.	91.	157.	148.	12.0	184.	0.	0.0
25	445.	94.	156.	148.	14.0	184.	0.	0.0
26	460.	97.	152.	146.	16.0	184.	0.	0.0

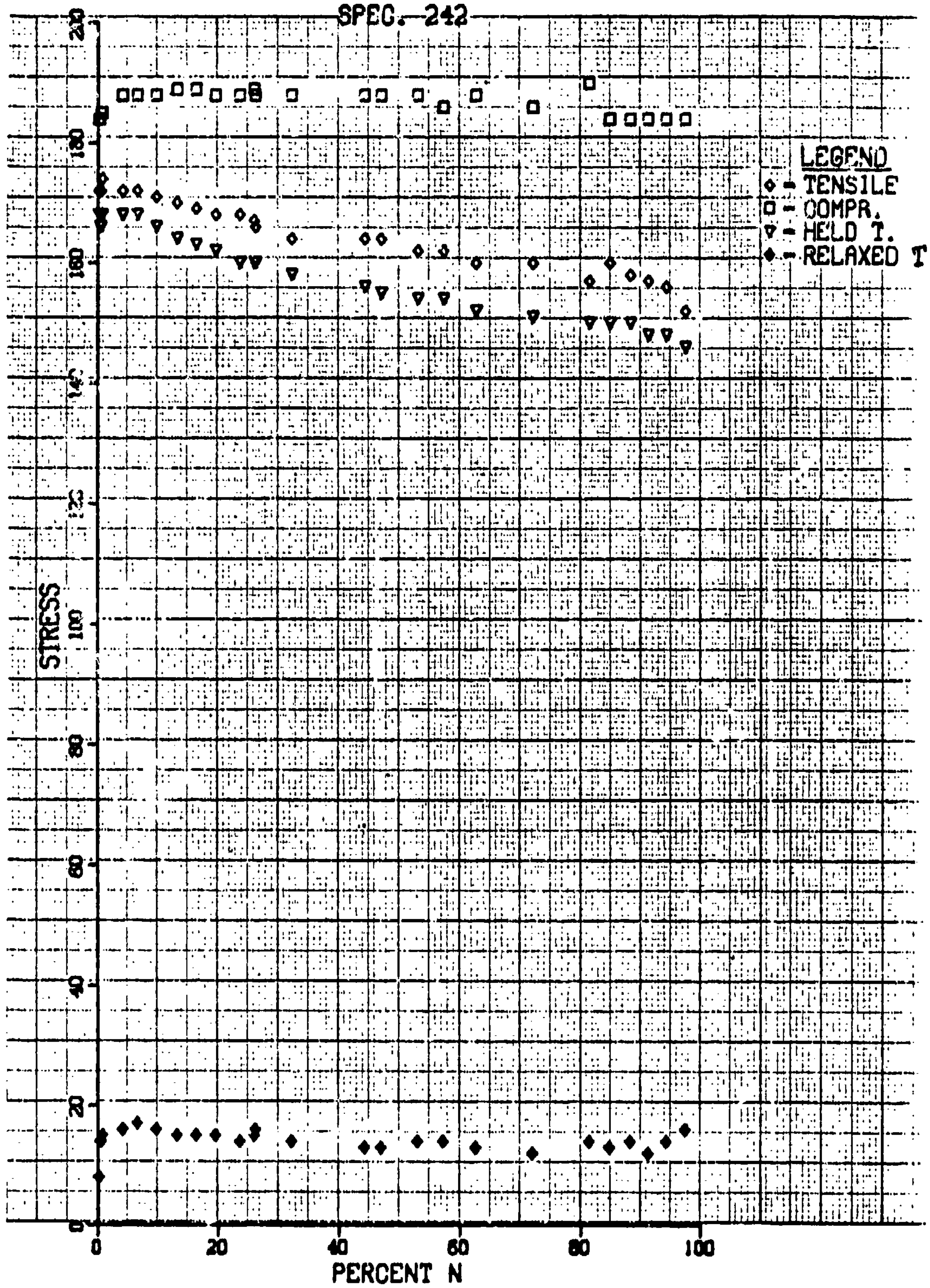

SPEC. 242
LEGEND
◇ - TENSILE
□ - COMPR.
▽ - HELD T.
◆ - RELAXED T
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 52.

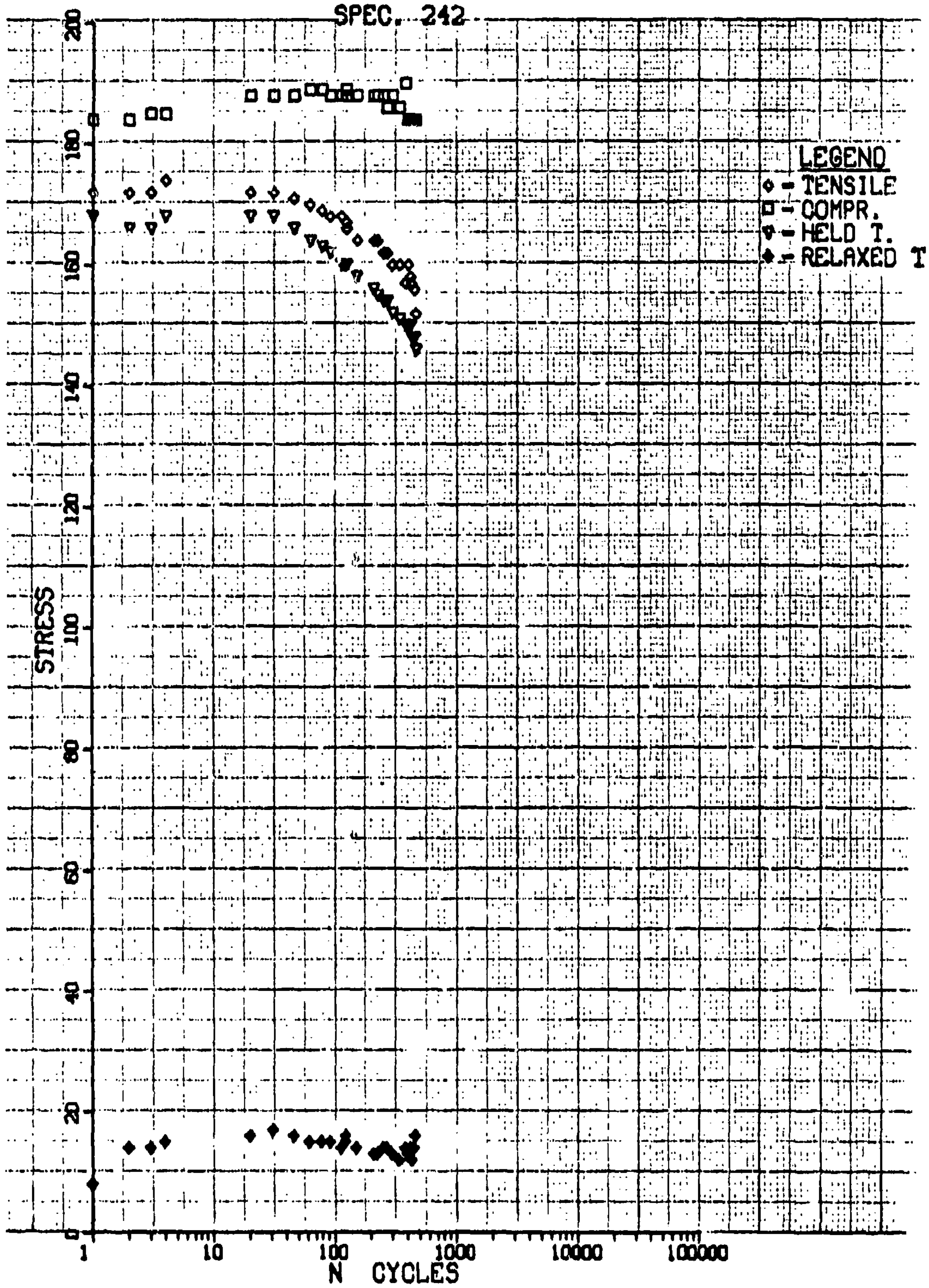

SPEC. 242
LEGEND
◇ - TENSILE
□ - COMPR.
▽ - HELD T.
◆ - RELAXED T
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 53.

TABLE 35

SPECIMEN 246

I	N	%N	PEAK TENSILE	HELD TENSILE	RELAXED TENSILE	PEAK COMPR.	HELD COMPR.	RELAXED COMPR.
1	1.	0.	171.	167.	10.2	185.	0.	0.0
2	2.	1.	175.	168.	23.2	185.	0.	0.0
3	3.	1.	176.	160.	16.4	180.	0.	0.0
4	4.	2.	175.	157.	17.0	188.	0.	0.0
5	5.	2.	176.	160.	21.4	186.	0.	0.0
6	6.	2.	175.	157.	20.2	185.	0.	0.0
7	8.	3.	175.	156.	19.6	186.	0.	0.0
8	11.	4.	175.	154.	18.0	187.	0.	0.0
9	13.	5.	175.	153.	18.0	186.	0.	0.0
10	16.	6.	175.	152.	18.4	188.	0.	0.0
11	17.	7.	175.	152.	17.2	188.	0.	0.0
12	20.	8.	175.	152.	17.6	188.	0.	0.0
13	23.	9.	173.	151.	18.2		0.	0.0
14	29.	11.	174.	150.	18.0	189.	0.	0.0
15	32.	13.	174.	150.	16.8	189.	0.	0.0
16	39.	15.	174.	149.	18.0	189.	0.	0.0
17	40.	16.	175.	149.	16.4	189.	0.	0.0
18	48.	19.	173.	148.	17.2	189.	0.	0.0
19	58.	23.	172.	147.	17.0	191.	0.	0.0
20	69.	27.	172.	147.	16.0	189.	0.	0.0
21	77.	30.	172.	147.	17.4	190.	0.	0.0
22	86.	34.	172.	146.	16.8	190.	0.	0.0
23	96.	38.	172.	145.	15.4	190.	0.	0.0
24	97.	38.	171.	145.	17.2	190.	0.	0.0
25	98.	39.	173.	144.	13.2	189.	0.	0.0
26	99.	39.	172.	146.	15.8	189.	0.	0.0
27	105.	42.	172.	145.	15.6	190.	0.	0.0
28	117.	46.	171.	144.	16.4	190.	0.	0.0
29	124.	49.	170.	144.	16.6	192.	0.	0.0
30	125.	49.	171.	144.	16.0	191.	0.	0.0
31	134.	53.	171.	144.	15.6	190.	0.	0.0
32	145.	57.	171.	144.	17.2	190.	0.	0.0
33	153.	60.	171.	143.	16.0	190.	0.	0.0
34	156.	[illegible]	169.	143.	16.0	190.	0.	0.0
35	162.	64.	169.	142.	15.4	191.	0.	0.0
36	172.	68.	169.	143.	16.4	190.	0.	0.0
37	181.	72.	168.	143.	17.0	191.	0.	0.0
38	183.	72.	169.	143.	16.0	190.	0.	0.0
39	192.	76.	168.	142.	16.8	191.	0.	0.0
40	202.	80.	168.	141.	15.0	190.	0.	0.0
41	210.	[illegible]	168.	142.	16.2	190.	0.	0.0
42	[illegible]	84.	169.	141.	15.2	190.	0.	0.0
43	220.	87.	168.	140.	16.0	191.	0.	0.0
44	229.	91.	166.	140.	16.8	192.	0.	0.0
45	230.	91.	168.	140.	14.0	190.	0.	0.0
46	239.	94.	167.	140.	15.4	190.	0.	0.0
47	251.	99.	165.	140.	16.4	191.	0.	0.0

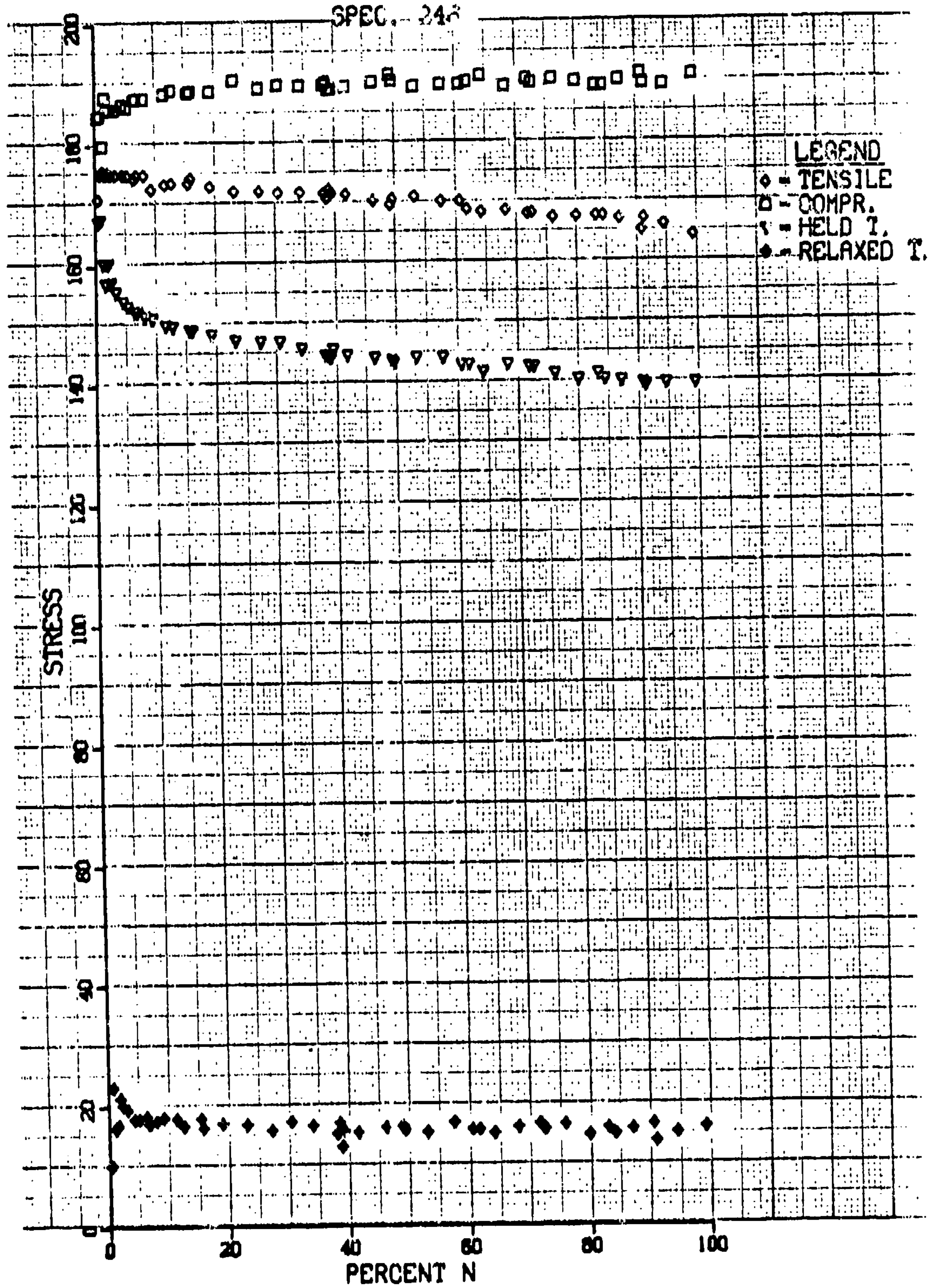
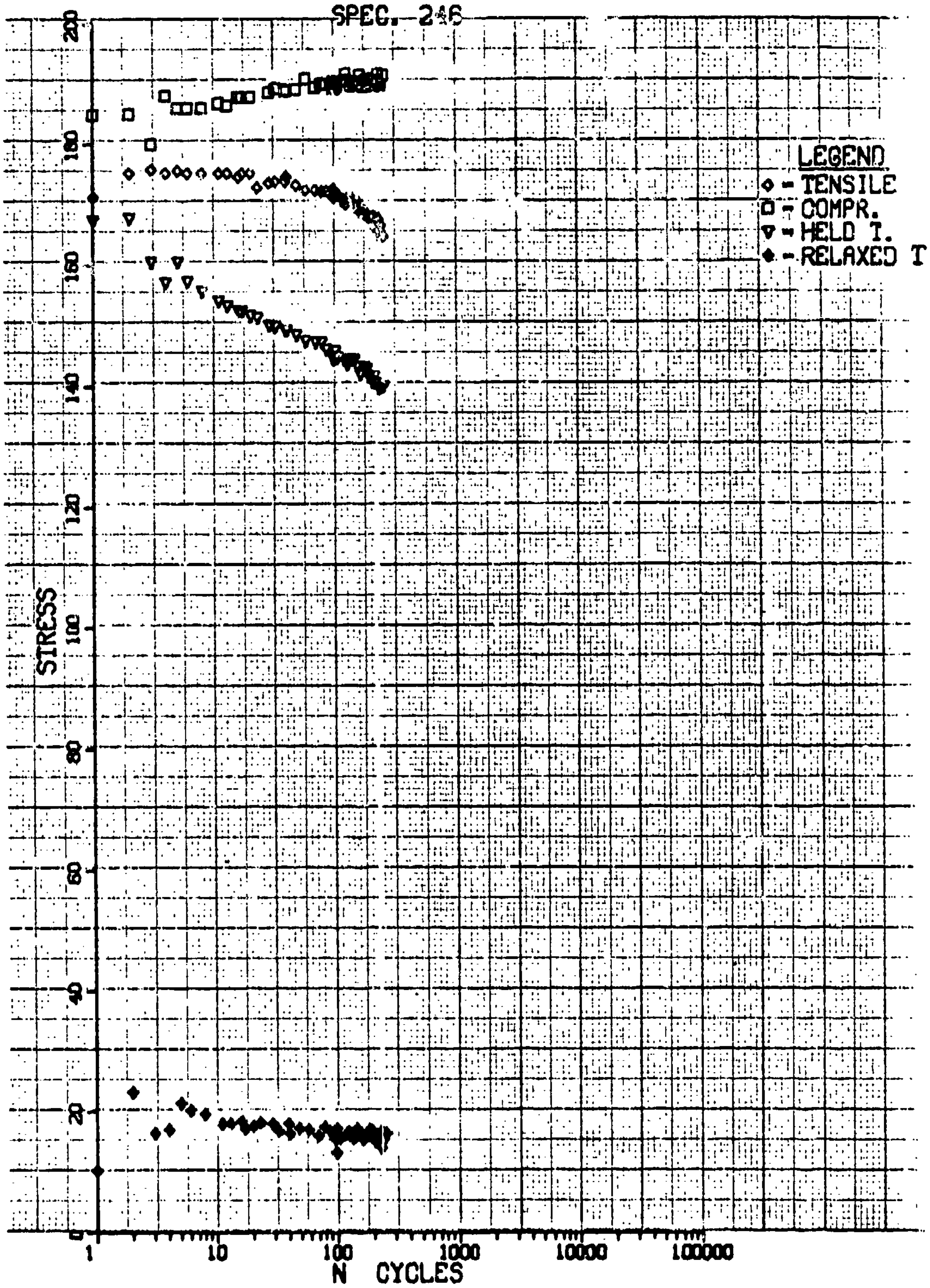

SPEC. 24?
LEGEND
◇ - TENSILE
□ - COMPR.
▽ - HELD T.
◆ - RELAXED T.
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N

Figure 54.



SPEC. 246
LEGEND
◇ - TENSILE
□ - COMPR.
▽ - HELD T.
◆ - RELAXED T
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 55.

TABLE 36

SPECIMEN 244

I	N	%N	PEAK TENSILE	HELD TENSILE	RELAXED TENSILE	PEAK COMPR.	HELD COMPR.	RELAXED COMPR.
1	1.	0.	170.	160.	4.0	176.	0.	0.0
2	2.	0.	168.	150.	13.0	175.	0.	0.0
3	3.	1.	168.	159.	11.0	175.	0.	0.0
4	4.	1.	168.	159.	15.0	175.	0.	0.0
5	5.	1.	168.	159.	15.0	175.	0.	0.0
6	13.	3.	166.	158.	13.0	177.	0.	0.0
7	30.	7.	164.	154.	12.0	180.	0.	0.0
8	49.	11.	163.	153.	11.0	180.	0.	0.0
9	66.	13.	162.	152.	12.0	180.	0.	0.0
10	75.	17.	161.	151.	11.0	180.	0.	0.0
11	90.	20.	160.	149.	11.0	181.	0.	0.0
12	110.	25.	160.	149.	11.0	180.	0.	0.0
13	121.	27.	159.	148.	11.0	180.	0.	0.0
14	136.	30.	158.	148.	12.0	181.	0.	0.0
15	151.	34.	156.	146.	11.0	182.	0.	0.0
16	170.	36.	156.	146.	11.0	182.	0.	0.0
17	230.	51.	154.	144.	11.0	182.	0.	0.0
18	241.	54.	155.	144.	12.0	180.	0.	0.0
19	290.	65.	154.	143.	11.0	180.	0.	0.0
20	321.	72.	151.	142.	12.0	182.	0.	0.0
21	340.	76.	152.	141.	10.0	181.	0.	0.0
22	367.	82.	152.	140.	9.0	180.	0.	0.0
23	411.	92.	151.	140.	11.0	180.	0.	0.0
24	426.	95.	152.	141.	11.0	180.	0.	0.0
25	430.	96.	150.	140.	12.0	180.	0.	0.0
26	441.	99.	156.	144.	10.0	180.	0.	0.0
27	444.	99.	157.	148.	12.0	180.	0.	0.0
28	446.	100.	160.	149.	13.0	180.	0.	0.0
29	447.	100.		152.			0.	0.0

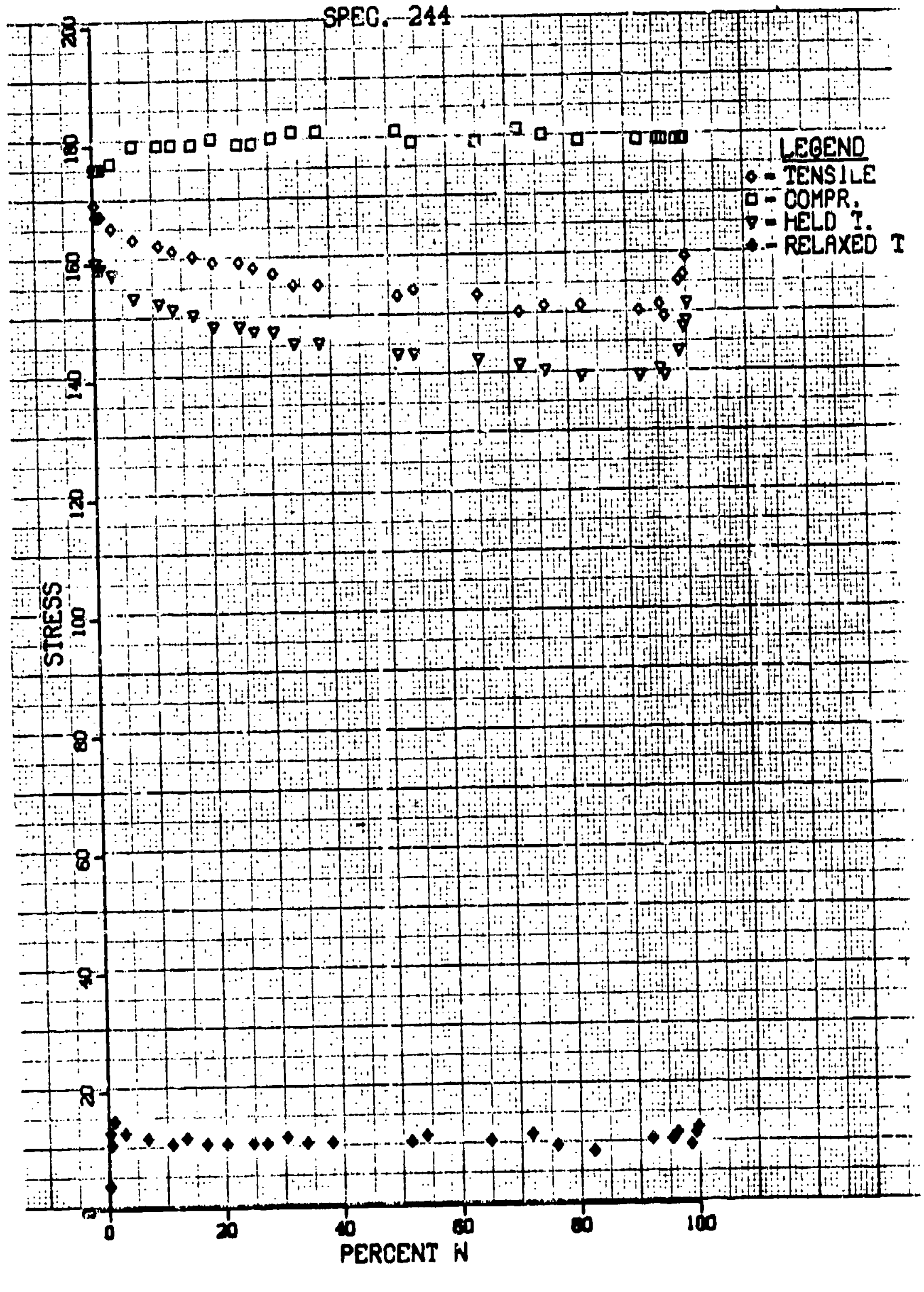
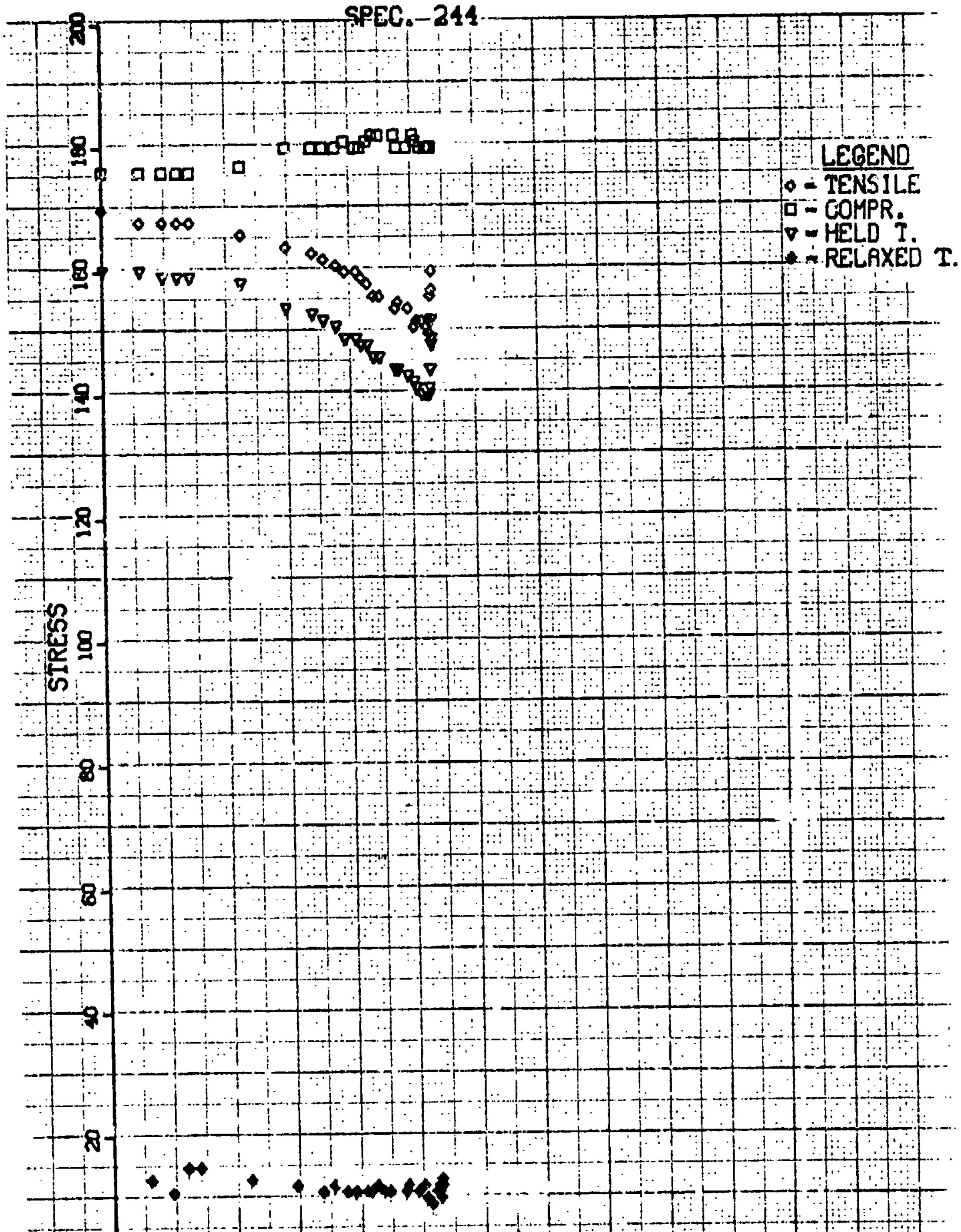

SPEC. 244
LEGEND
◇ - TENSILE
□ - COMPR.
▽ - HELD T.
◆ - RELAXED T
STRESS
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
PERCENT W

Figure 56.



SPEC. 244
LEGEND
◇ - TENSILE
□ - COMPR.
▽ - HELD T.
◆ - RELAXED T.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 57.

TABLE 37

SPECIMEN 232

I	N	%N	PEAK TENSILE	HELJ TENSILE	RELAXED TENSILE	PEAK COMPR.	HELD COMPR.	RELAKED COMPR.
1	1.	0.	172.	146.	0.0	156.	0.	0.0
2	2.	0.	172.	133.	1.0	164.	0.	0.0
3	3.	C.	172.	134.	0.0	164.	0.	0.0
4	4.	1.	172.	138.	4.0	164.	0.	0.0
5	5.	1.	172.	136.	2.0	164.	0.	0.0
6	6.	1.	172.	136.	4.0	164.	0.	0.0
7	7.	1.	172.	134.	3.0	165.	0.	0.0
8	8.	1.	170.	133.	5.0	165.	0.	0.0
9	15.	2.	170.	132.	6.0	166.	0.	0.0
10	388.	50.		120.	2.0		0.	0.0
11	381.	75.		120.	4.0		0.	0.0

SECTION 10

RENÉ 95 COMPRESSIVE-ONLY STRAIN-HOLD TESTS

This section contains data for compressive-only strain-hold tests performed on René 95. Hold periods of one and ten minutes were employed at the peak compressive strain and for one minute at a strain between the peak compressive and zero strain levels. The data are presented in Tables 38 through 46 and Figures 58 through 77.

TABLE 38

SPECIMEN 6

#	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	.48	173.	0.0	183.	6.3
2	2.	.97	175.	0.0	185.	15.0
3	30.	14.49	179.	0.0	186.	16.3
4	65.	31.40	178.	0.0	185.	16.3
5	75.	36.23	178.	0.0	184.	16.3
6	100.	48.31	178.	0.0	180.	12.5
7	110.	53.14	178.	0.0	180.	13.8
8	125.	60.39	178.	0.0	180.	15.0
9	150.	72.46	178.	0.0	179.	15.0
10	160.	77.29	178.	0.0	178.	12.5
11	180.	86.96	175.	0.0	176.	13.8
12	197.	95.17	174.	0.0	175.	13.8
13	200.	96.62	173.	0.0	176.	13.8
14	204.	98.55	170.	0.0	176.	13.8
15	205.	99.03	168.	0.0	176.	13.8
16	206.	99.52	161.	0.0	178.	15.0

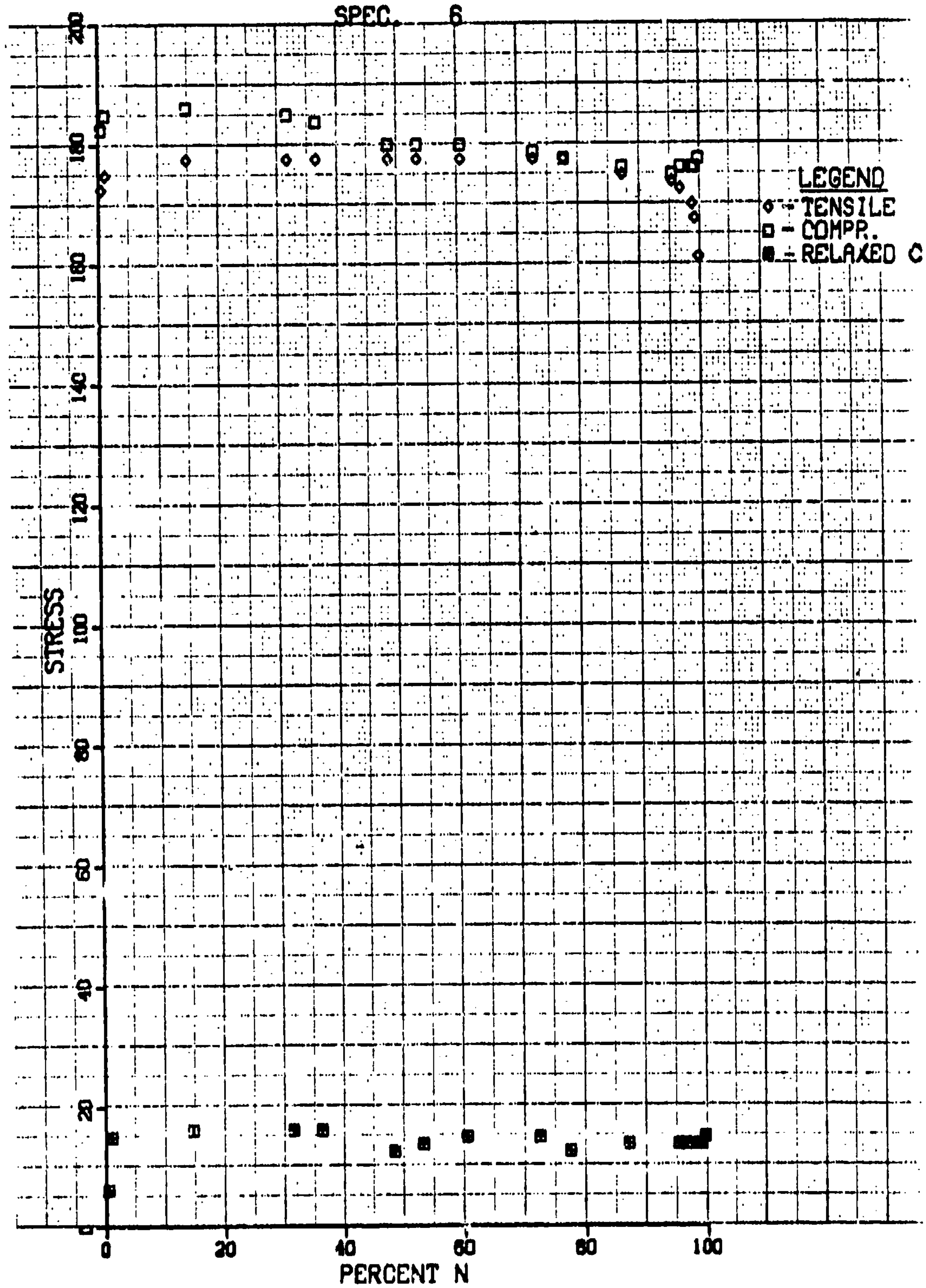

SPEC. 6
LEGEND
◇ - TENSILE
□ - COMPR.
■ - RELAXED C
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 58.

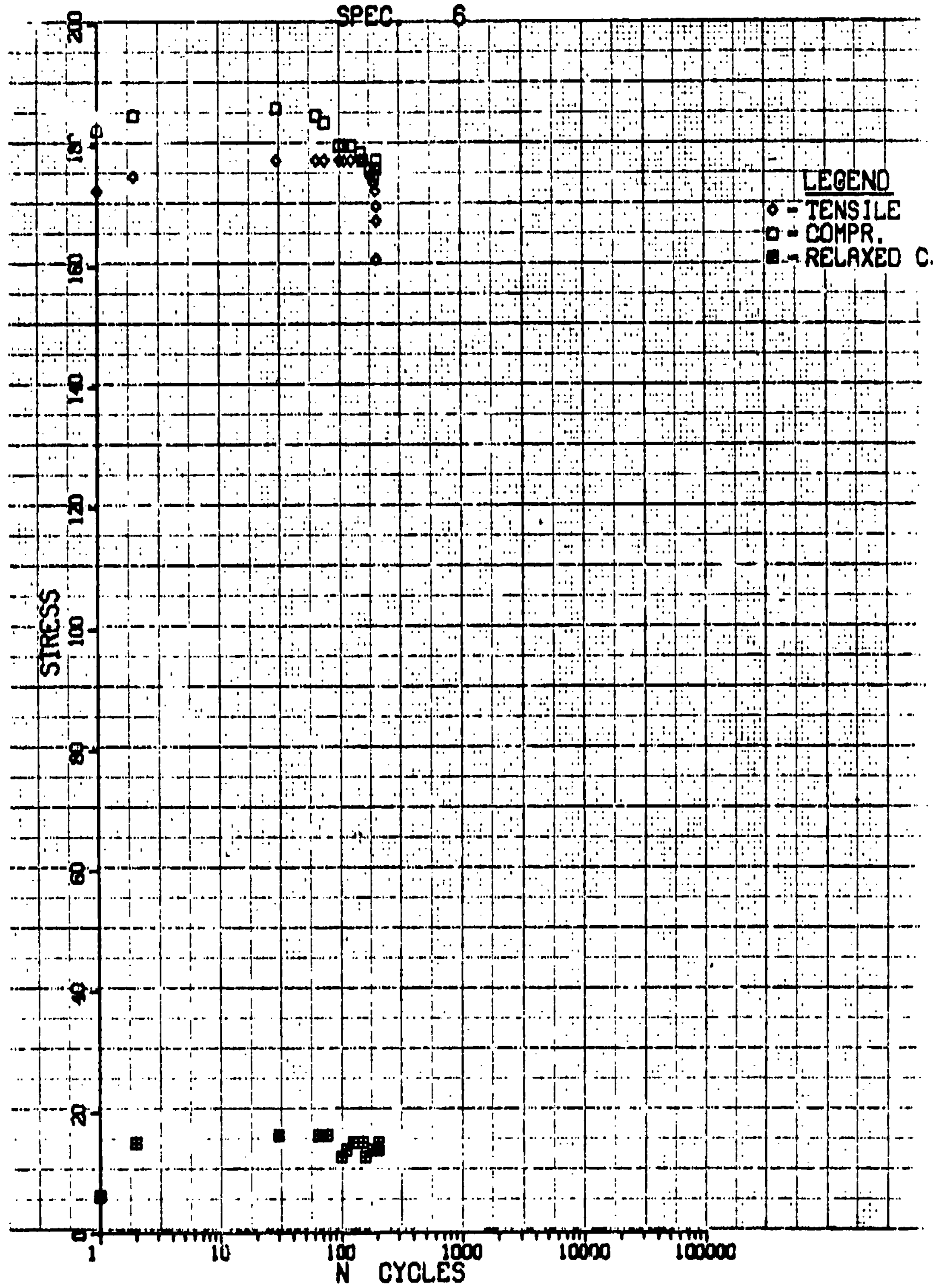

SPEC. 6
STRESS
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
100000
N CYCLES
LEGEND
◇ - TENSILE
□ - COMPR.
■ - RELAXED C.

Figure 59.

TABLE 39

SPECIMEN 11

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			---------STRESSES-------			
1	1.	0.	160.	0.0	164.	10.0
2	2.	1.	158.	0.0	164.	12.5
3	3.	1.	159.	0.0	165.	13.8
4	5.	2.	159.	0.0	166.	16.3
5	15.	7.	161.	0.0	166.	15.3
6	20.	10.	163.	0.0	166.	16.3
7	40.	19.	163.	0.0	165.	16.3
8	48.	23.	163.	0.0	165.	17.5
9	61.	29.	163.	0.0	164.	15.3
10	71.	34.	163.	0.0	163.	15.3
11	90.	43.	163.	0.0	161.	15.0
12	101.	48.	163.	0.0	161.	15.3
13	112.	54.	163.	0.0	160.	15.0
14	141.	67.	161.	0.0	159.	13.8
15	160.	77.	161.	0.0	158.	12.5
16	165.	79.	161.	0.0	158.	13.8
17	170.	81.	161.	0.0	158.	15.0
18	176.	84.	161.	0.0	156.	13.8
19	182.	87.	161.	0.0	156.	12.5

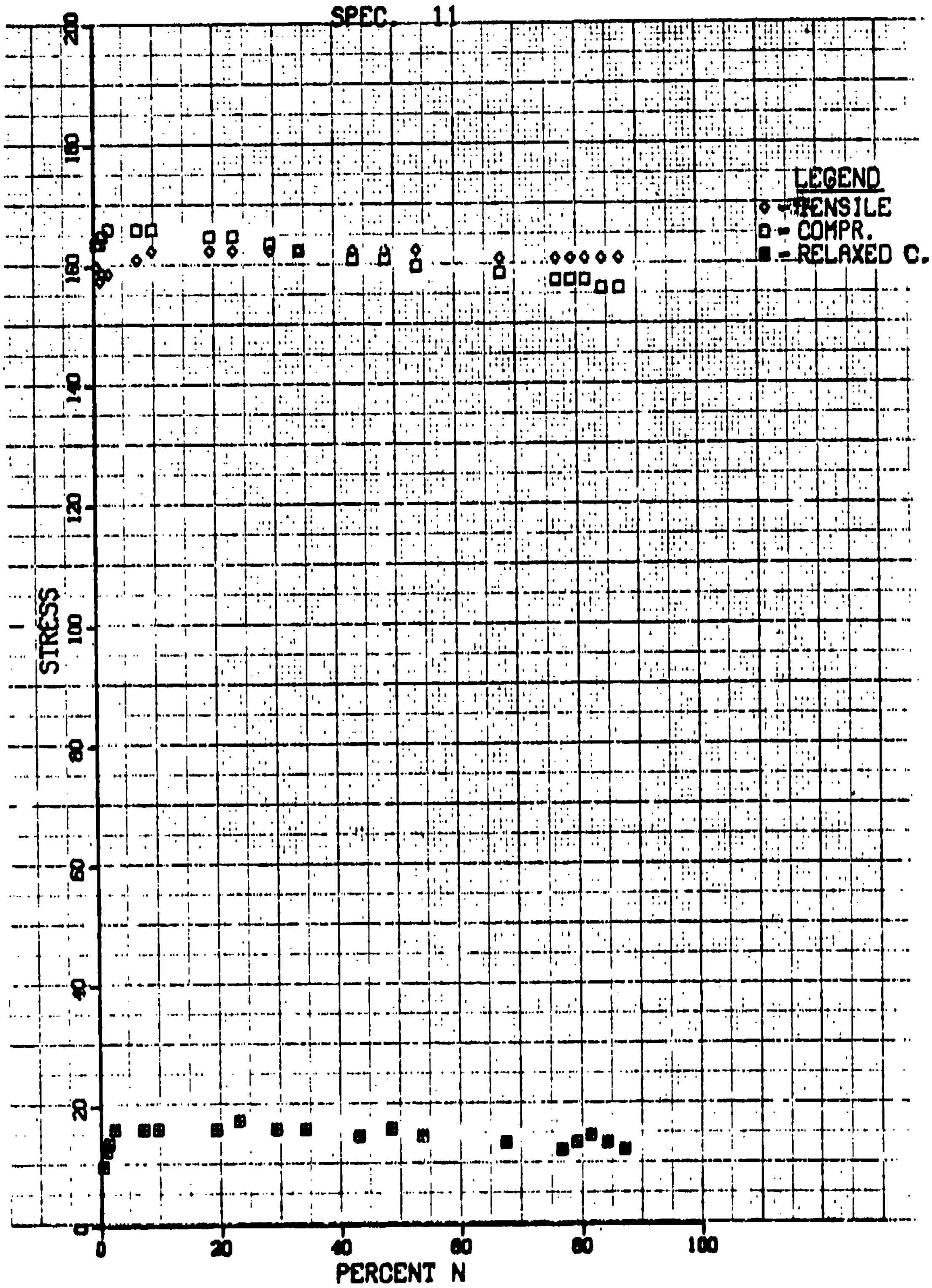

SPEC. 11
LEGEND
◇ - TENSILE
□ - COMPR.
■ - RELAXED C.
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N

Figure 60.

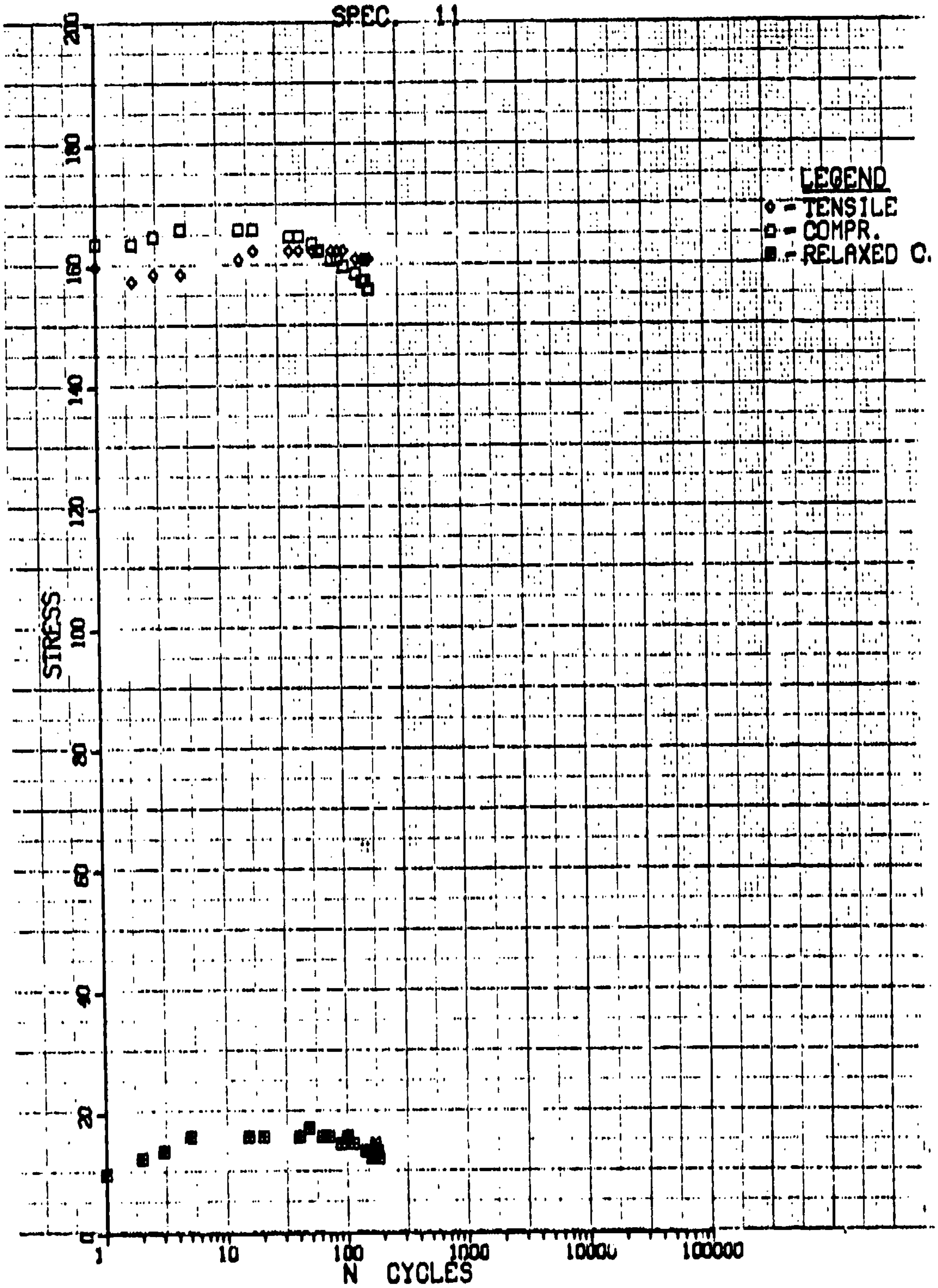
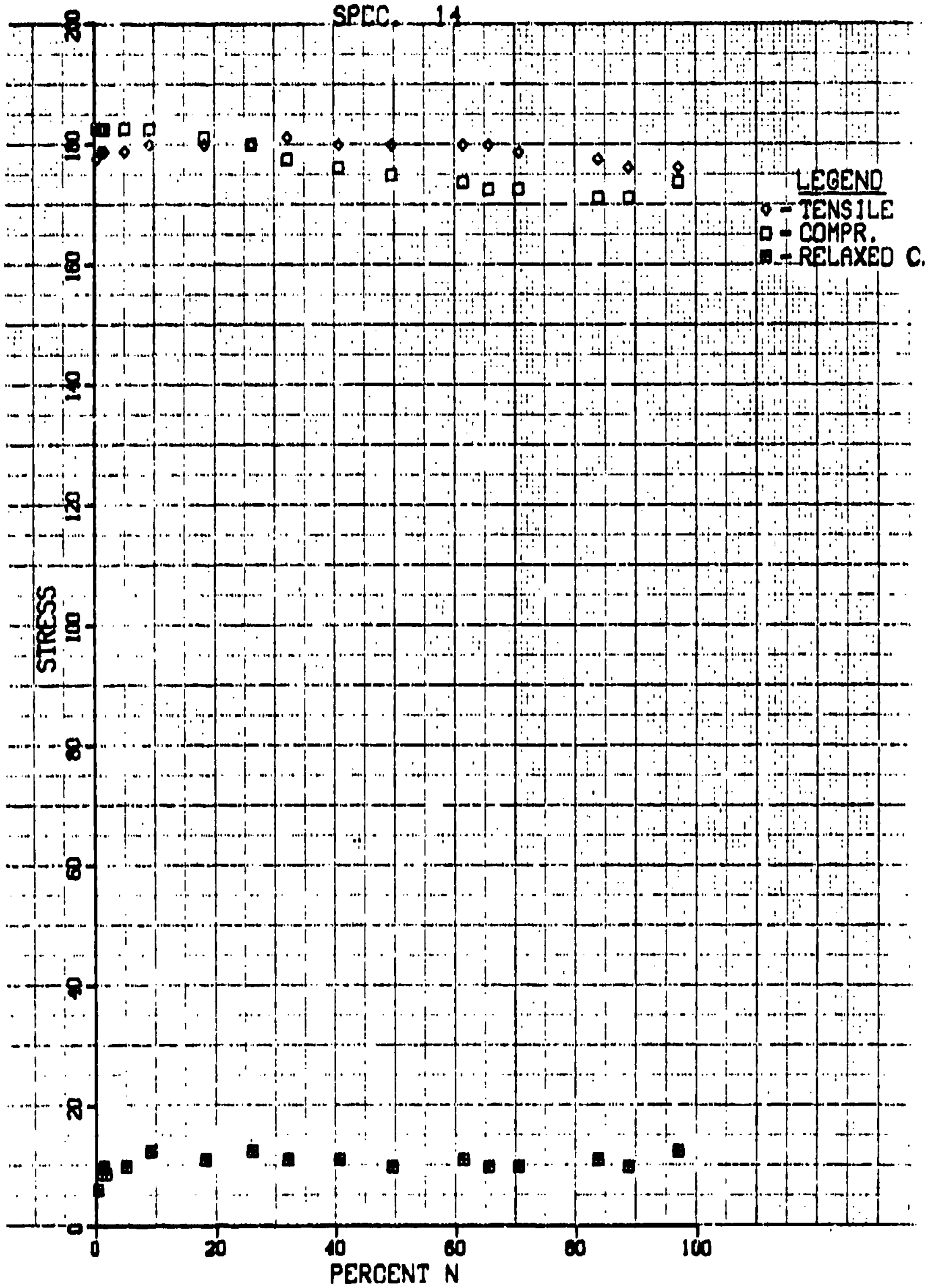

SPEC. 11
STRESS
N CYCLES
LEGEND
◇ = TENSILE
□ = COMPR.
■ = RELAXED C.
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
100000

Figure 61.

TABLE 40

SPECIMEN 14

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			---------STRESSES-------			
1	1.	0.	178.	0.0	183.	6.3
2	2.	1.	179.	0.0	183.	8.8
3	3.	1.	179.	0.0	183.	10.0
4	4.	2.	179.	0.0	183.	8.8
5	11.	5.	179.	0.0	183.	10.0
6	20.	9.	180.	0.0	183.	12.5
7	40.	18.	180.	0.0	181.	11.3
8	57.	26.	180.	0.0	180.	12.5
9	70.	32.	181.	0.0	178.	11.3
10	89.	41.	180.	0.0	176.	11.3
11	108.	49.	180.	0.0	175.	10.0
12	134.	61.	180.	0.0	174.	11.3
13	143.	65.	180.	0.0	173.	10.0
14	154.	70.	179.	0.0	173.	10.0
15	183.	84.	178.	0.0	171.	11.3
16	194.	89.	176.	0.0	171.	10.0
17	212.	97.	176.	0.0	174.	12.5



SPEC. 14
LEGEND
◇ - TENSILE
□ - COMPR.
■ - RELAXED C.
STRESS
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
PERCENT N

Figure 62.

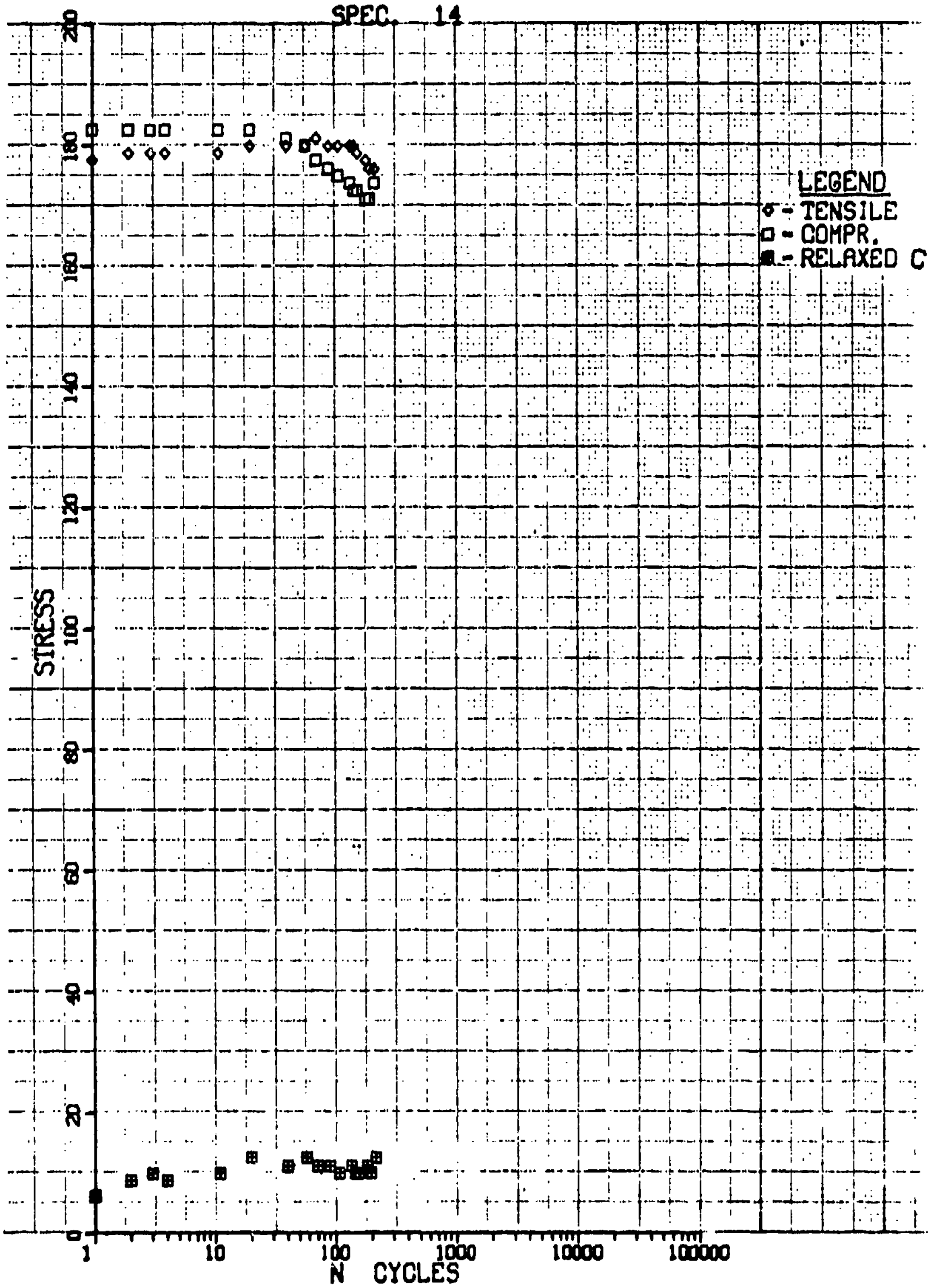

SPEC. 14
LEGEND
- TENSILE
- COMPR.
- RELAXED C
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 63.

TABLE 41

SPECIMEN 8

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			---------STRESSES-------			
1	1.	0.	158.	0.0		
2	2.	0.	163.	0.0	169.	6.3
3	3.	1.	160.	0.0	170.	8.8
4	4.	1.	160.	0.0	168.	6.3
5	5.	1.	160.	0.0	169.	12.5
6	6.	1.	163.	0.0	166.	10.0
7	8.	2.	165.	0.0	166.	7.5
8	13.	3.	165.	0.0	166.	7.5
9	28.	7.	165.	0.0	165.	7.5
10	30.	7.	166.	0.0	165.	7.5
11	100.	24.	165.	0.0	163.	7.5
12	125.	30.	165.	0.0	160.	6.3
13	150.	36.	165.	0.0	158.	6.3
14	225.	54.	165.	0.0	155.	5.0
15	250.	61.	165.	0.0	156.	7.5
16	275.	67.	165.	0.0	155.	7.5
17	350.	85.	163.	0.0	153.	6.3
18	380.	92.	161.	0.0	153.	6.3
19	385.	93.	160.	0.0	155.	7.5
20	401.	97.	159.	0.0	154.	7.5
21	405.	98.	158.	0.0	155.	7.5
22	410.	99.	155.	0.0	155.	7.5
23	411.	100.	153.	0.0	155.	5.0
24	412.	100.	151.	0.0	156.	7.5
25	413.	100.	150.	0.0	156.	7.5
26	414.	100.	143.	0.0		

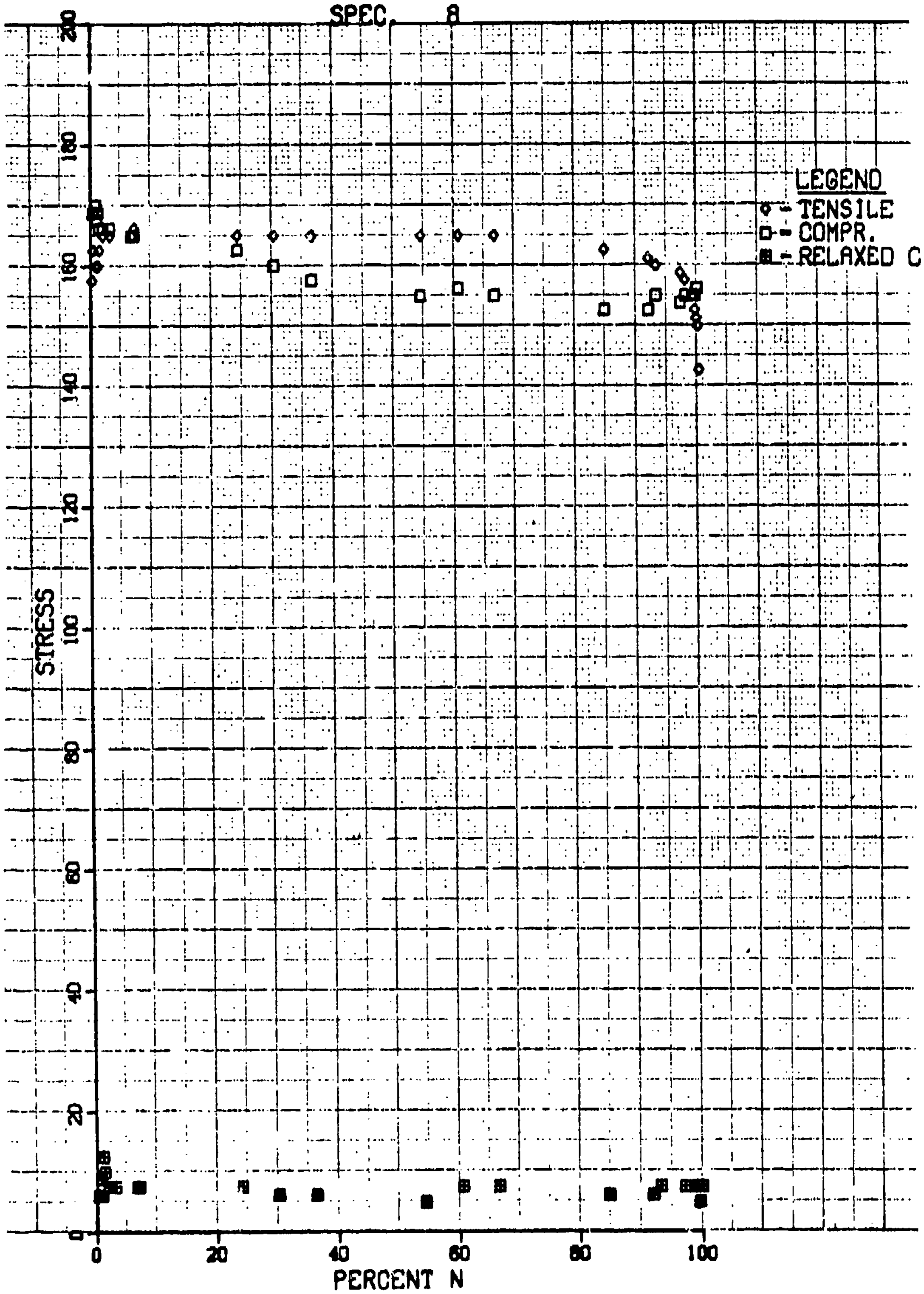

SPEC. 8
LEGEND
TENSILE
COMPR.
RELAXED C
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 64.

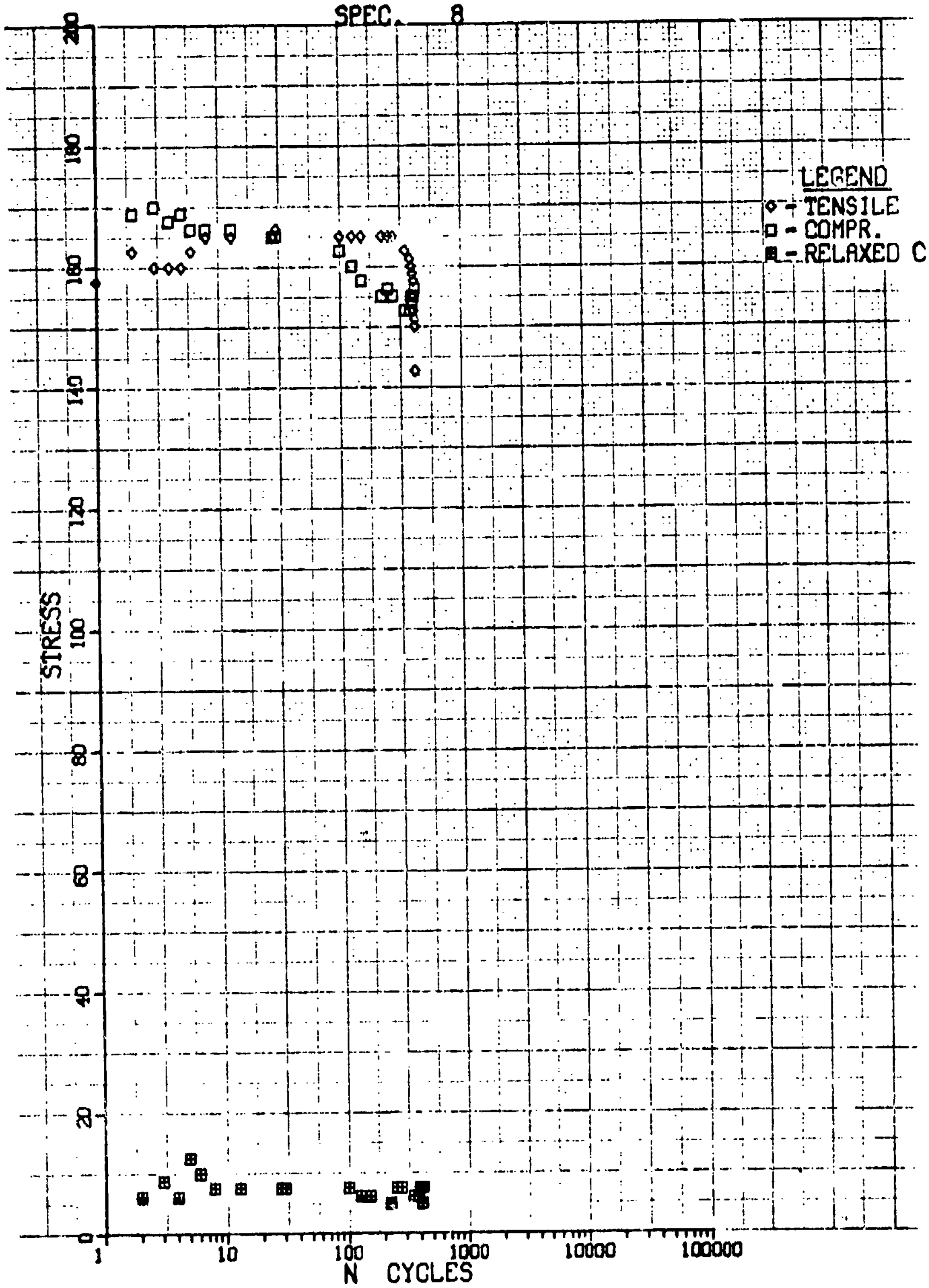
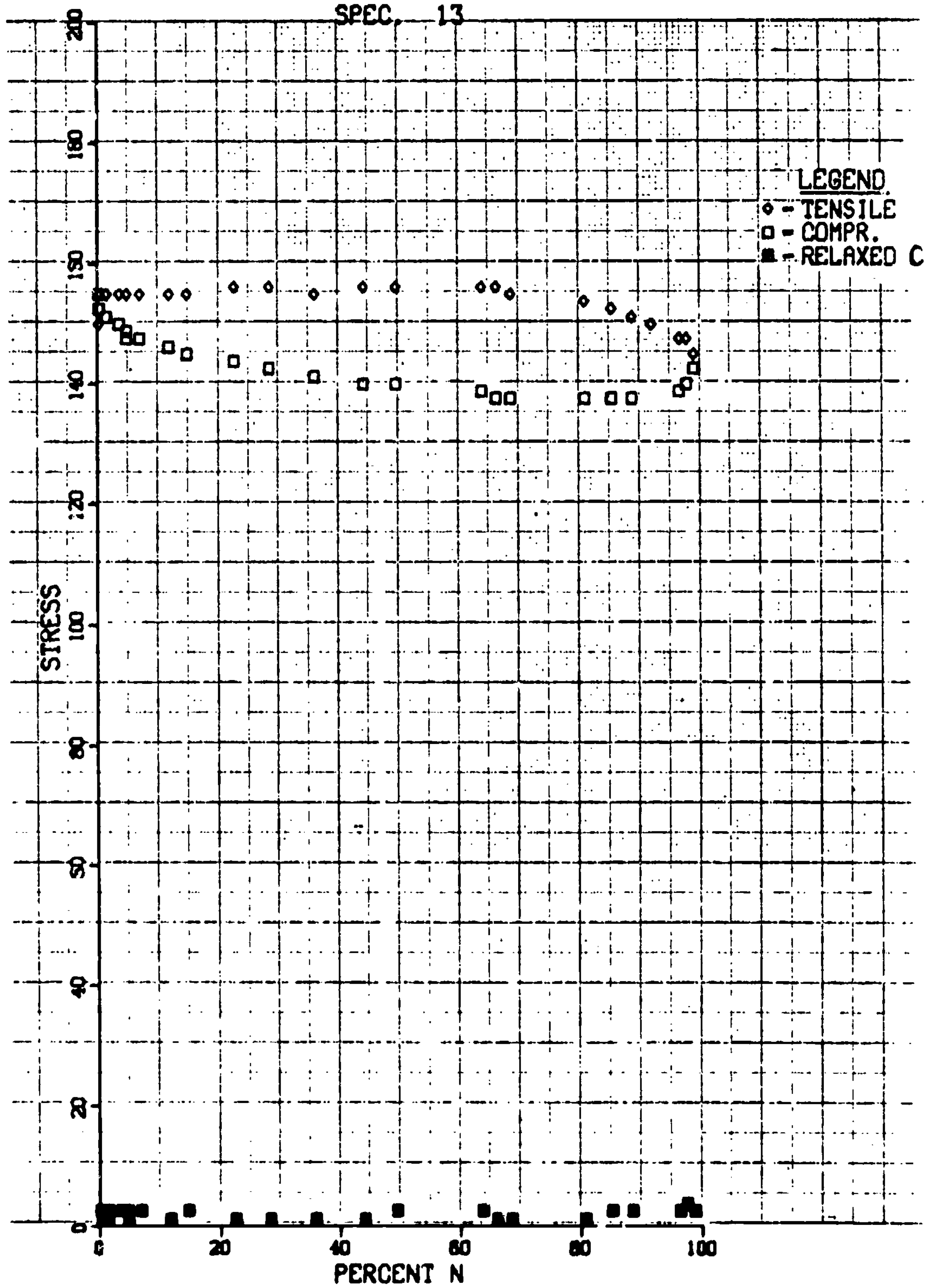

SPEC. 8
LEGEND
◇ - TENSILE
□ - COMPR.
⊞ - RELAXED C
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 65.

TABLE 42

SPECIMEN 13

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			---------STRESSES-------			
1	1.	0.	150.	0.0	155.	2.5
2	2.	0.	155.	0.0	153.	2.5
3	3.	0.	155.	0.0	153.	1.3
4	11.	1.	155.	0.0	151.	1.3
5	13.	2.	155.	0.0	151.	2.5
6	30.	4.	155.	0.0	150.	2.5
7	40.	5.	155.	0.0	148.	1.3
8	41.	5.	155.	0.0	149.	2.5
9	59.	7.	155.	0.0	148.	2.5
10	99.	12.	155.	0.0	146.	1.3
11	125.	15.	155.	0.0	145.	2.5
12	191.	23.	156.	0.0	144.	1.3
13	240.	28.	156.	0.0	143.	1.3
14	304.	36.	155.	0.0	141.	1.3
15	374.	44.	156.	0.0	140.	1.3
16	420.	50.	156.	0.0	140.	2.5
17	540.	64.	156.	0.0	139.	2.5
18	560.	66.	156.	0.0	138.	1.3
19	581.	69.	155.	0.0	138.	1.3
20	683.	81.	154.	0.0	138.	1.3
21	720.	85.	153.	0.0	138.	2.5
22	750.	89.	151.	0.0	138.	2.5
23	777.	92.	150.	0.0		
24	816.	96.	148.	0.0	139.	2.5
25	825.	98.	148.	0.0	140.	3.8
26	835.	99.	145.	0.0	143.	2.5



SPEC. 13
LEGEND
◇ - TENSILE
□ - COMPR.
■ - RELAXED C
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 66.

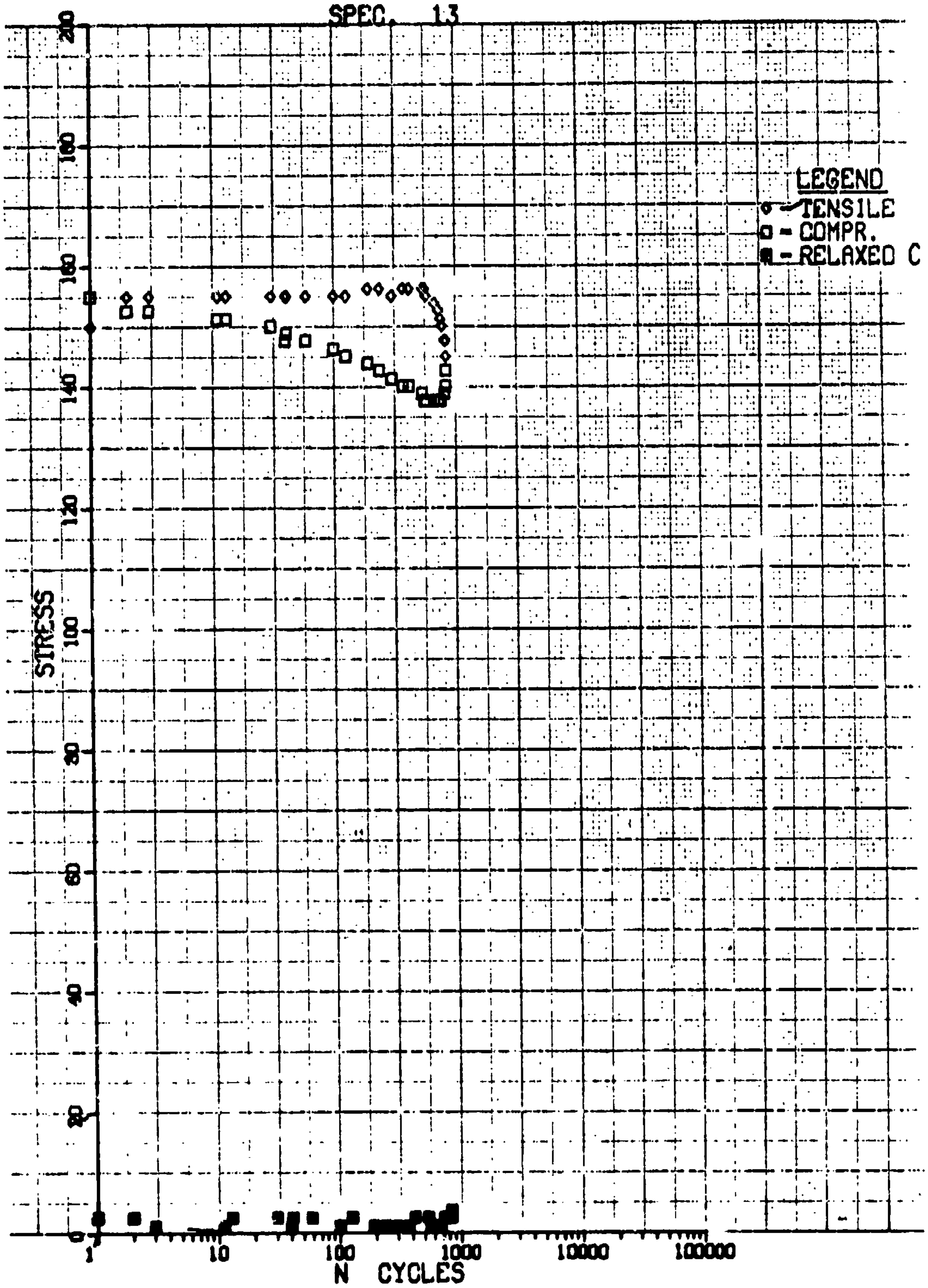

SPEC. 13
STRESS
200
180
160
140
120
100
80
60
40
20
0
LEGEND
TENSILE
COMPR.
RELAXED C
1
10
100
1000
10000
100000
N CYCLES

Figure 67.

TABLE 43

SPECIMEN 16

			---------STRESSES-------			
I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	121.	0.0	125.	0.0
2	2.	0.	128.	0.0	121.	0.0
3	3.	0.	128.	0.0	121.	0.0
4	26.	1.	126.	0.0	123.	0.0
5	70.	2.	125.	0.0	123.	0.0
6	98.	3.	125.	0.0	124.	0.0
7	320.	10.	124.	0.0	125.	0.0
8	1200.	39.	124.	0.0	124.	0.0
9	1349.	44.	125.	0.0	124.	0.0
10	1501.	49.	125.	0.0	123.	0.0
11	1716.	55.	125.	0.0	121.	0.0
12	1850.	60.	126.	0.0	121.	0.0
13	2522.	82.	125.	0.0	121.	0.0
14	2775.	90.	124.	0.0	121.	0.0
15	3028.	98.	124.	0.0	121.	0.0
16	3054.	99.	125.	0.0	123.	0.0
17	3069.	99.	130.	0.0	125.	0.0
18	3074.	99.	130.	0.0	126.	0.0
19	3083.	100.	133.	0.0	129.	-1.3
20	3084.	100.	134.	0.0	130.	0.0
21	3086.	100.	135.	0.0	131.	0.0
22	3088.	100.	135.	0.0	133.	0.0
23	3089.	100.	135.	0.0	135.	0.0

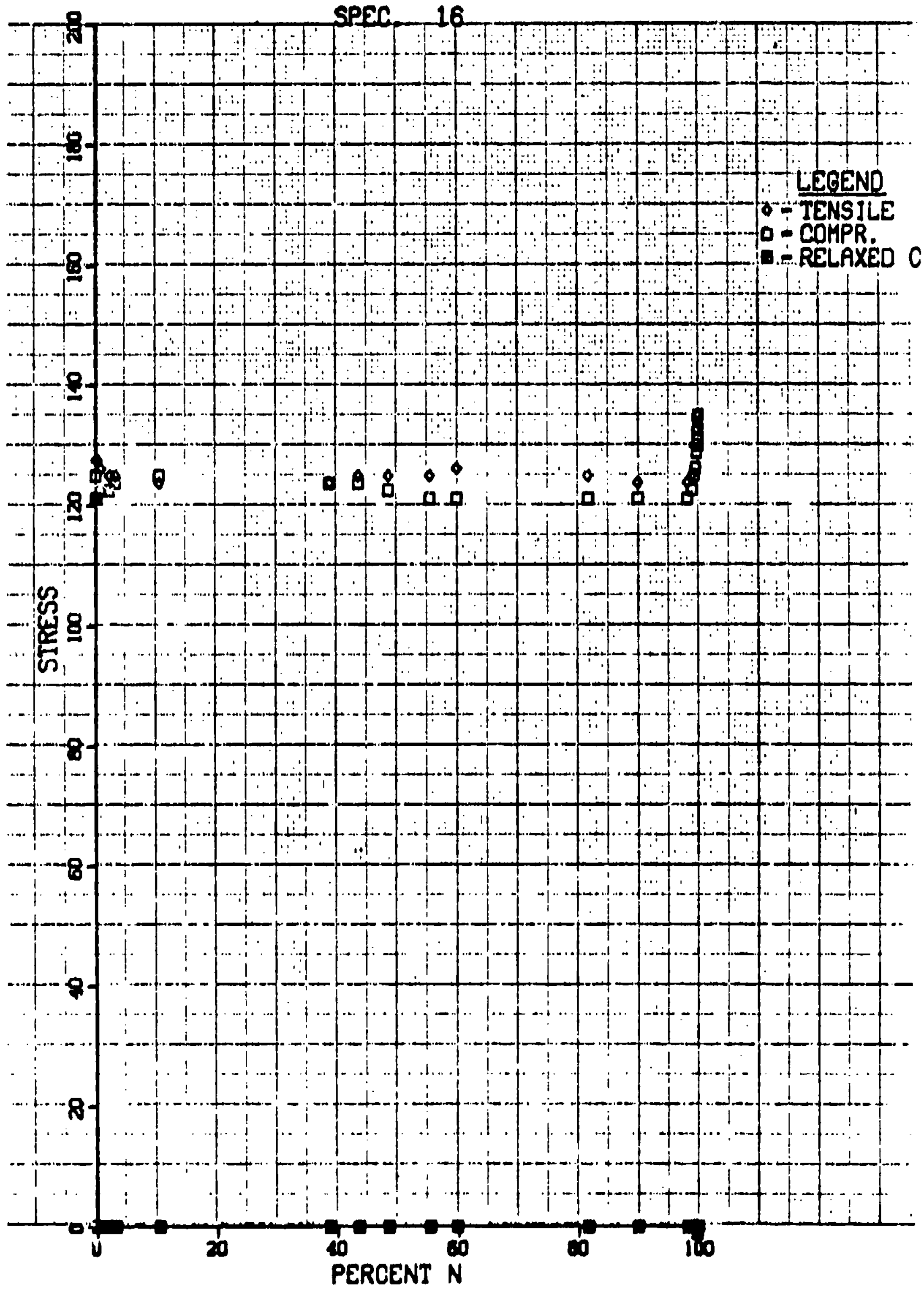


Figure 68.

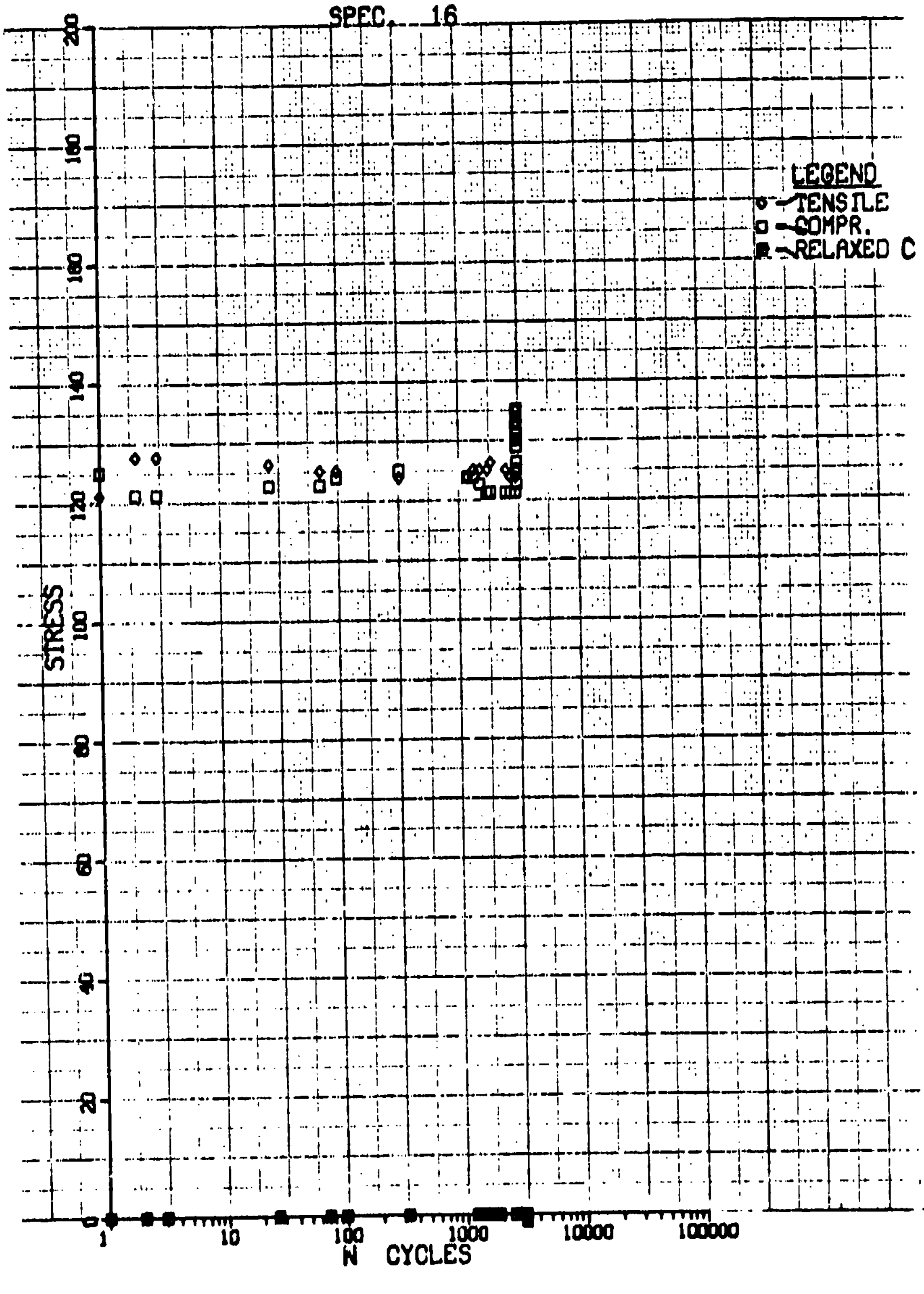

SPEC. 16
LEGEND
TENSILE
COMPR.
RELAXED C
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 69.

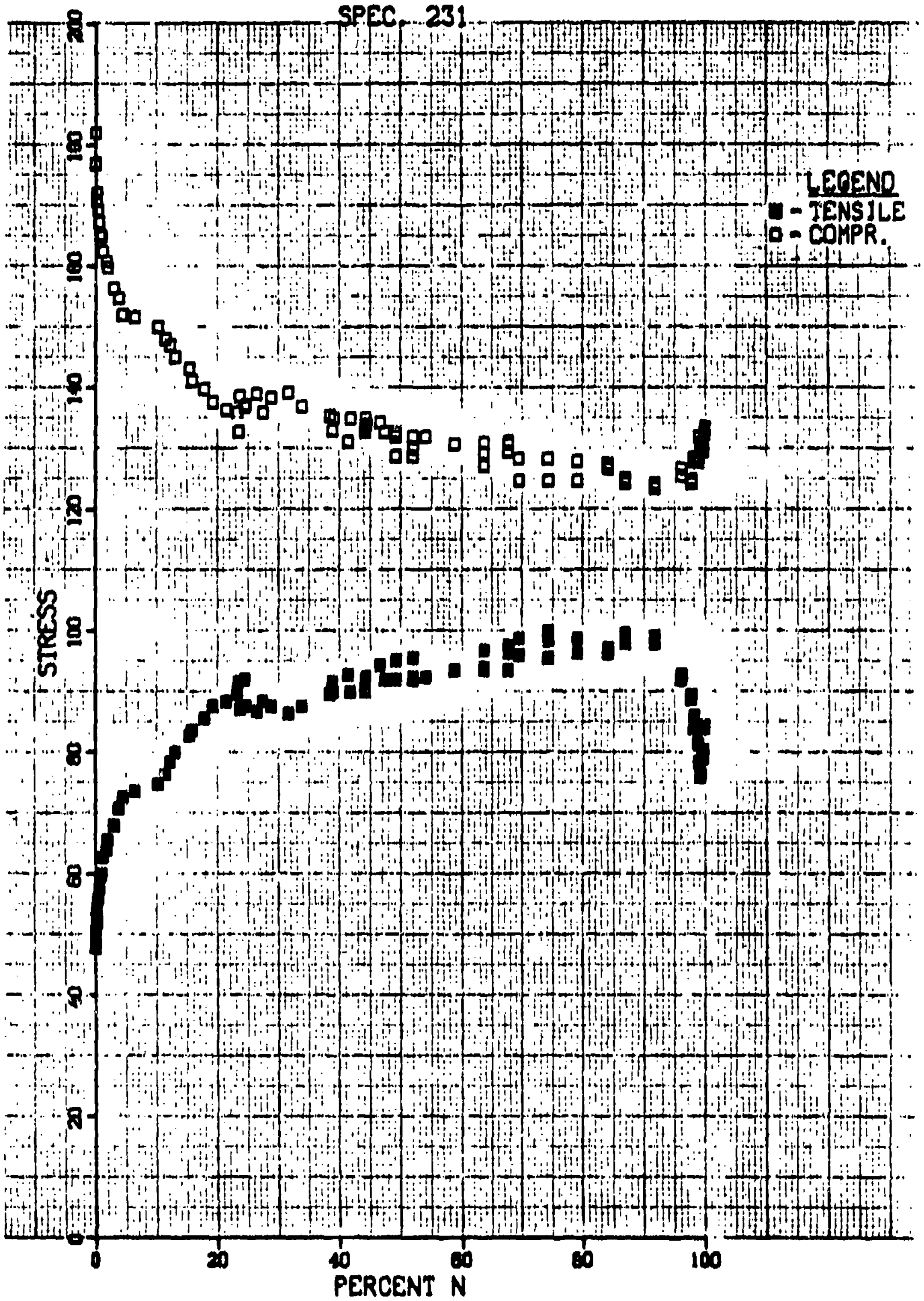

SPEC. 231
LEGEND
■ - TENSILE
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
PERCENT N

Figure 70.

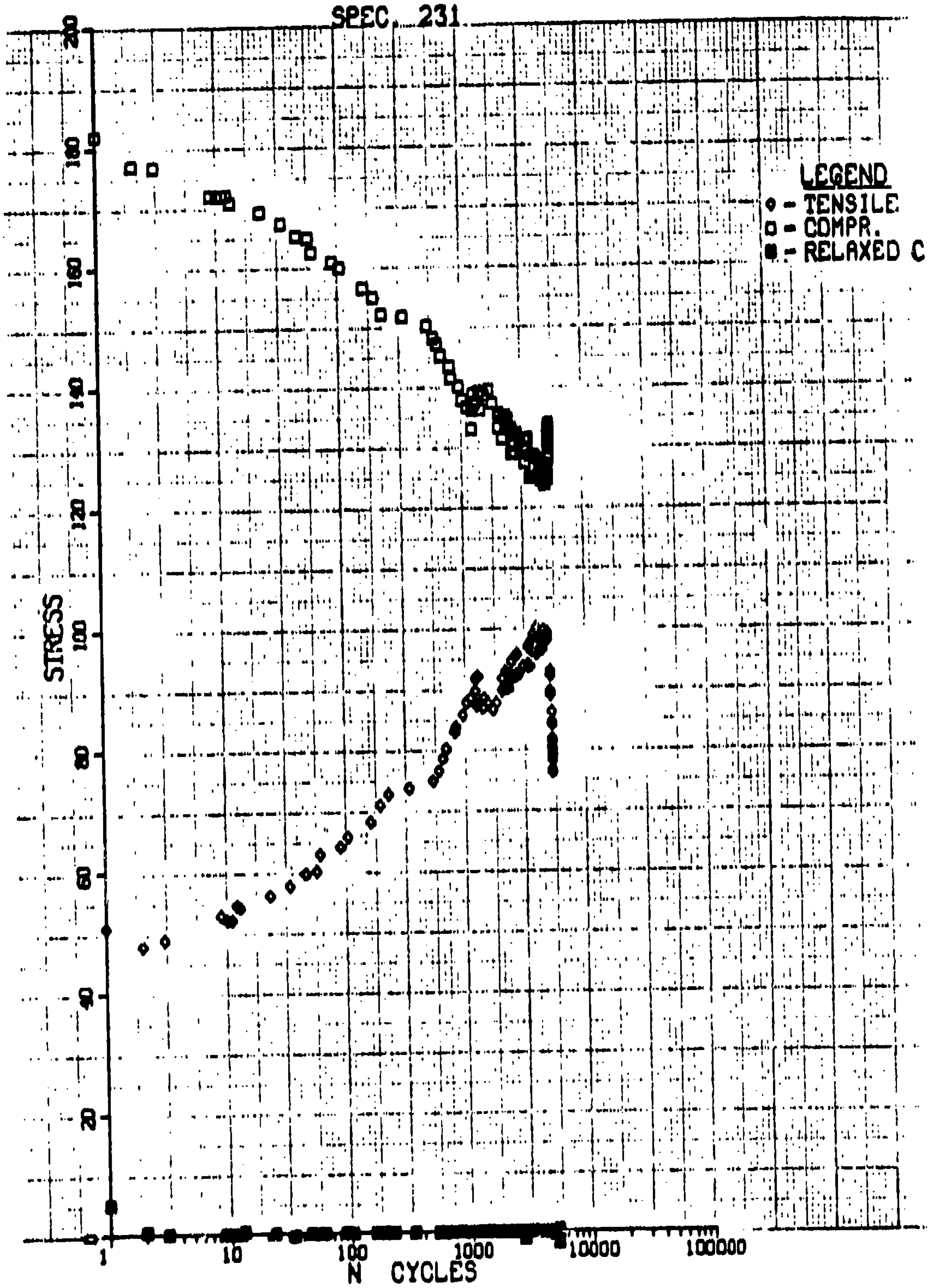

SPEC. 231
LEGEND
◇ - TENSILE
□ - COMPR.
■ - RELAXED C
STRESS
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
100000
N CYCLES

Figure 71.

TABLE 44

SPECIMEN 222

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	162.	0.0	174.	5.0
2	2.	1.	166.	0.0	171.	4.0
3	3.	1.		0.0	172.	
4	5.	2.	166.	0.0	169.	4.0
5	7.	3.	168.	0.0	169.	5.0
6	13.	6.	168.	0.0	167.	6.0
7	21.	9.	169.	0.0	165.	5.0
8	29.	13.	170.	0.0	163.	3.0
9	38.	17.	172.	0.0	163.	6.0
10	45.	20.	172.	0.0	162.	5.0
11	53.	24.	172.	0.0	160.	4.0
12	55.	25.	173.	0.0	160.	6.0
13	63.	28.	174.	0.0	159.	5.0
14	70.	31.	174.	0.0	158.	5.0
15	77.	34.	174.	0.0	157.	4.0
16	85.	38.	174.	0.0	157.	5.0
17	87.	39.	176.	0.0	156.	6.0
18	110.	49.	176.	0.0	155.	6.0
19	111.	50.	176.	0.0	154.	4.0
20	133.	59.	176.	0.0	153.	5.0
21	134.	60.	176.	0.0	152.	4.0
22	148.	66.	176.	0.0	156.	6.0
23	156.	70.	176.	0.0	154.	5.0
24	163.	73.	176.	0.0	153.	5.0
25	172.	77.	176.	0.0	152.	3.0
26	180.	80.	176.	0.0	152.	3.0
27	189.	84.	176.	0.0	153.	4.0
28	197.	88.	177.	0.0	151.	6.0
29	204.	91.	174.	0.0	151.	3.0
30	212.	95.	172.	0.0	151.	3.0
31	219.	98.	170.	0.0	152.	6.0
32	220.	98.	168.	0.0	152.	4.0
33	221.	99.	166.	0.0	153.	5.0
34	222.	99.		0.0	154.	

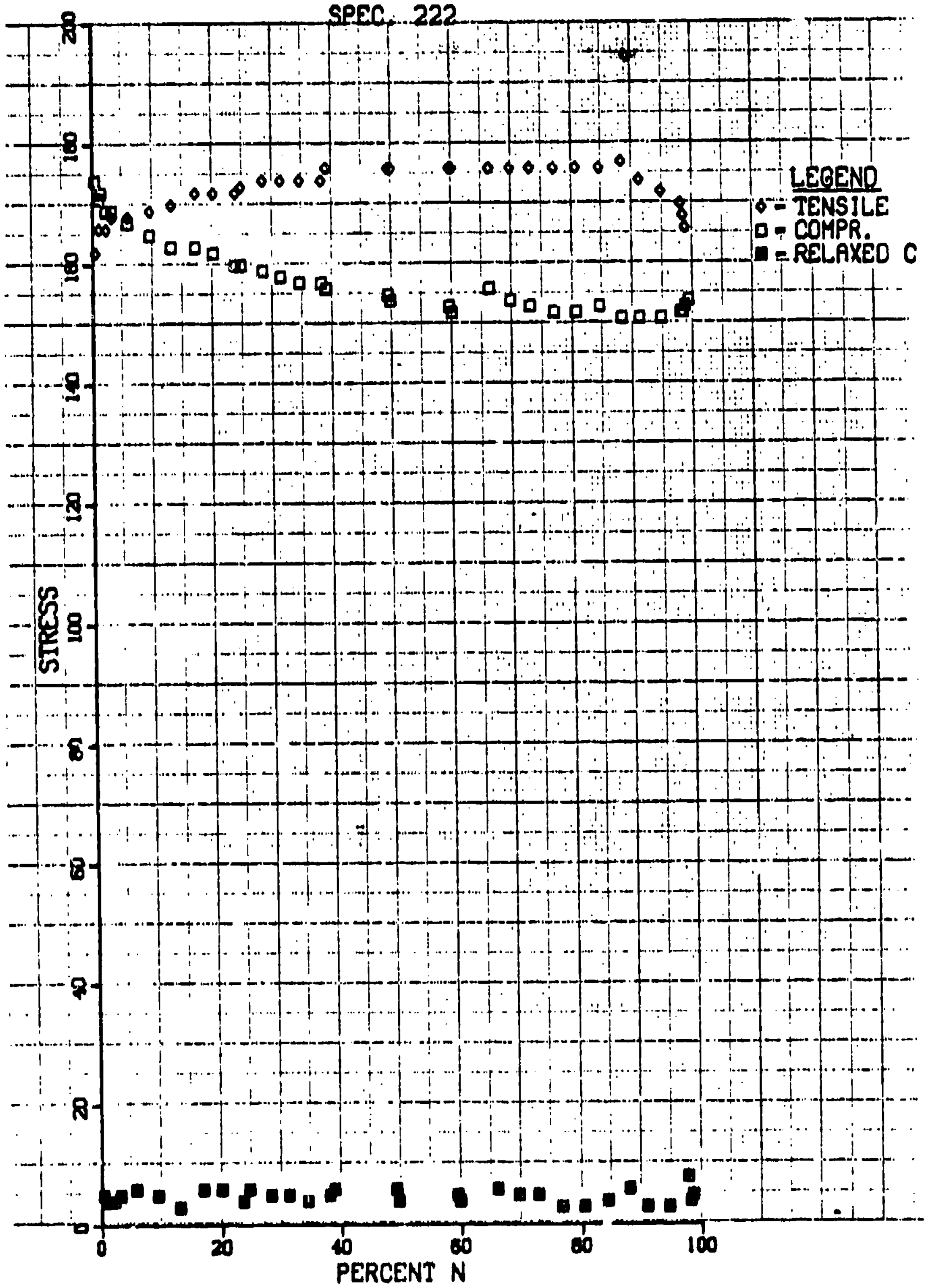

SPEC. 222
LEGEND
◇ = TENSILE
□ = COMPR.
■ = RELAXED C
STRESS
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
PERCENT N

Figure 72.

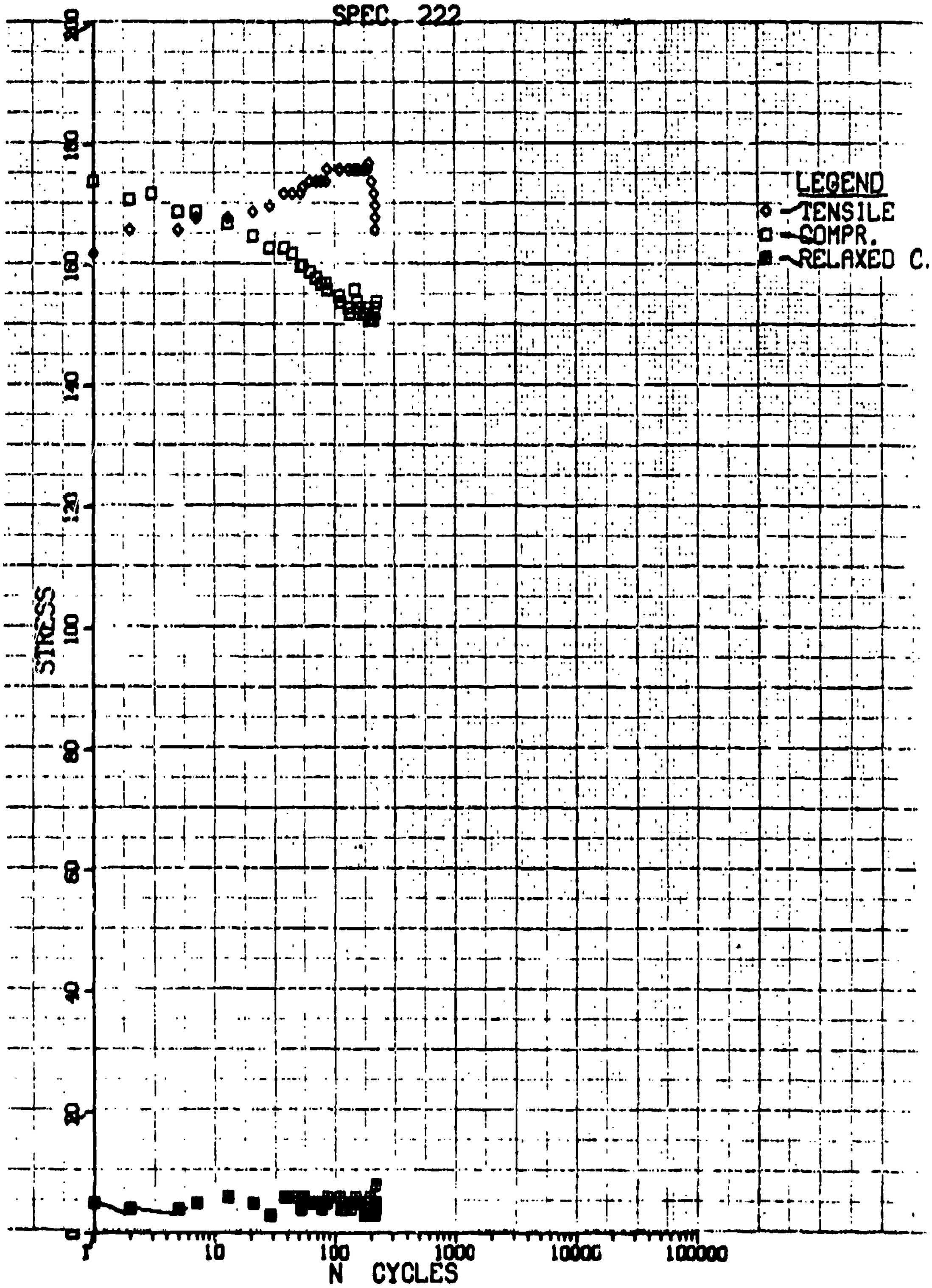
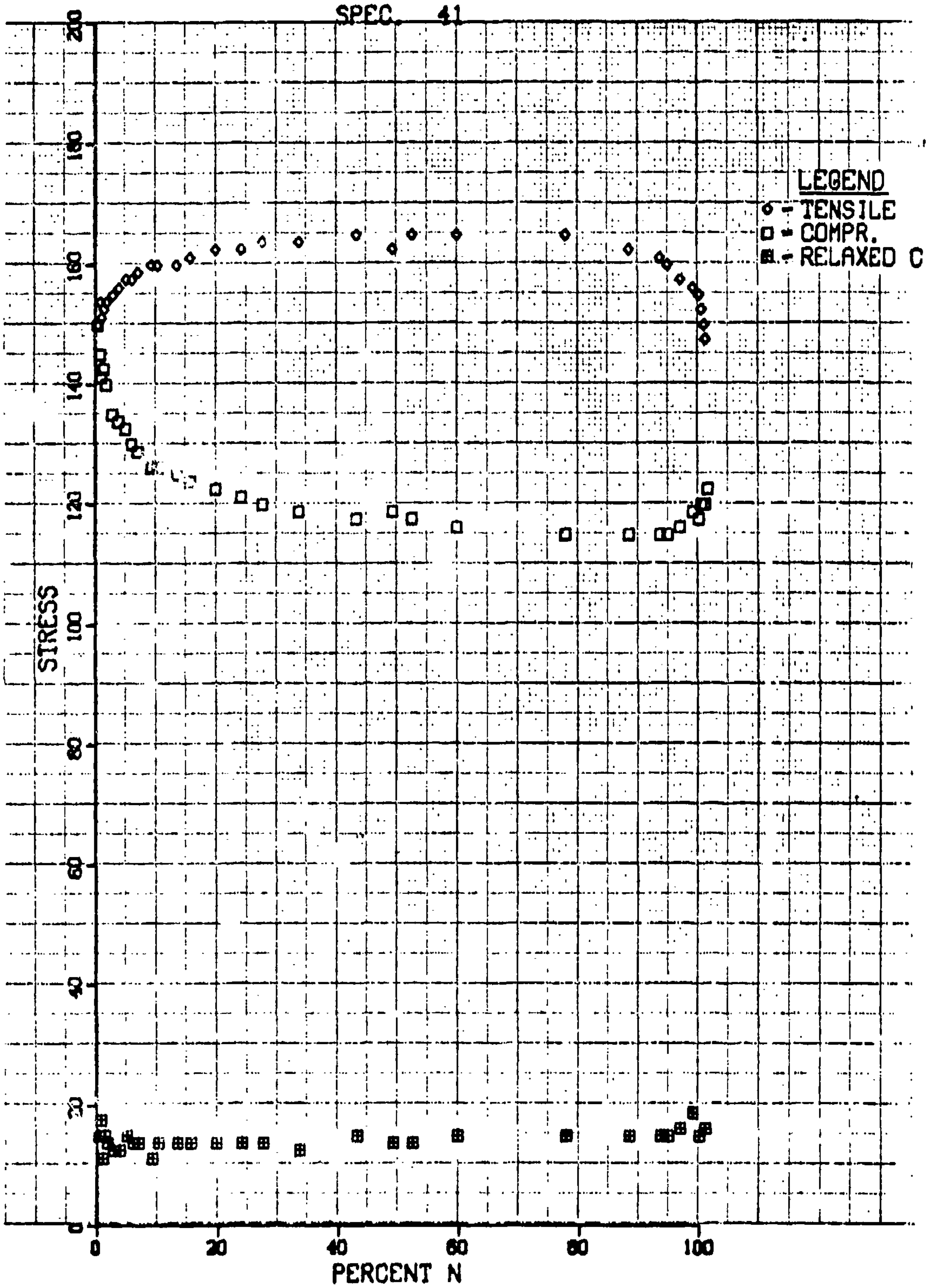

SPEC. 222
LEGEND
TENSILE
COMPR.
RELAXED C.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 73.

TABLE 45

SPECIMEN 41

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	150.	0.0	150.	15.0
2	2.	1.	154.	0.0	145.	17.5
3	3.	1.	151.	0.0	141.	11.3
4	4.	1.	153.	0.0	143.	15.0
5	5.	2.	154.	0.0	140.	13.8
6	8.	3.	155.	0.0	135.	12.5
7	11.	4.	156.	0.0	134.	12.5
8	14.	5.	158.	0.0	133.	15.0
9	17.	6.	158.	0.0	130.	13.8
10	20.	7.	159.	0.0	129.	13.8
11	26.	9.	160.	0.0	126.	11.3
12	29.	10.	160.	0.0	126.	13.8
13	38.	13.	160.	0.0	125.	13.8
14	44.	16.	161.	0.0	124.	13.8
15	56.	20.	163.	0.0	123.	13.8
16	68.	24.	163.	0.0	121.	13.8
17	78.	28.	164.	0.0	120.	13.8
18	95.	34.	164.	0.0	119.	12.5
19	122.	43.	165.	0.0	118.	15.0
20	139.	49.	163.	0.0	119.	13.8
21	148.	52.	165.	0.0	118.	13.8
22	169.	60.	165.	0.0	116.	15.0
23	220.	78.	165.	0.0	115.	15.0
24	250.	88.	163.	0.0	115.	15.0
25	265.	94.	161.	0.0	115.	15.0
26	268.	95.	160.	0.0	115.	15.0
27	274.	97.	158.	0.0	116.	16.3
28	280.	99.	156.	0.0	119.	18.8
29	283.	100.	155.	0.0	118.	15.0
30	284.	100.	153.	0.0	120.	
31	285.	101.	150.	0.0		
32	286.	101.	148.	0.0	[illegible]	15.3
33	287.	101.		0.0	123.	


SPEC. 41
LEGEND
◇ - TENSILE
□ - COMPR.
⊞ - RELAXED C
STRESS
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
PERCENT N

Figur(74.

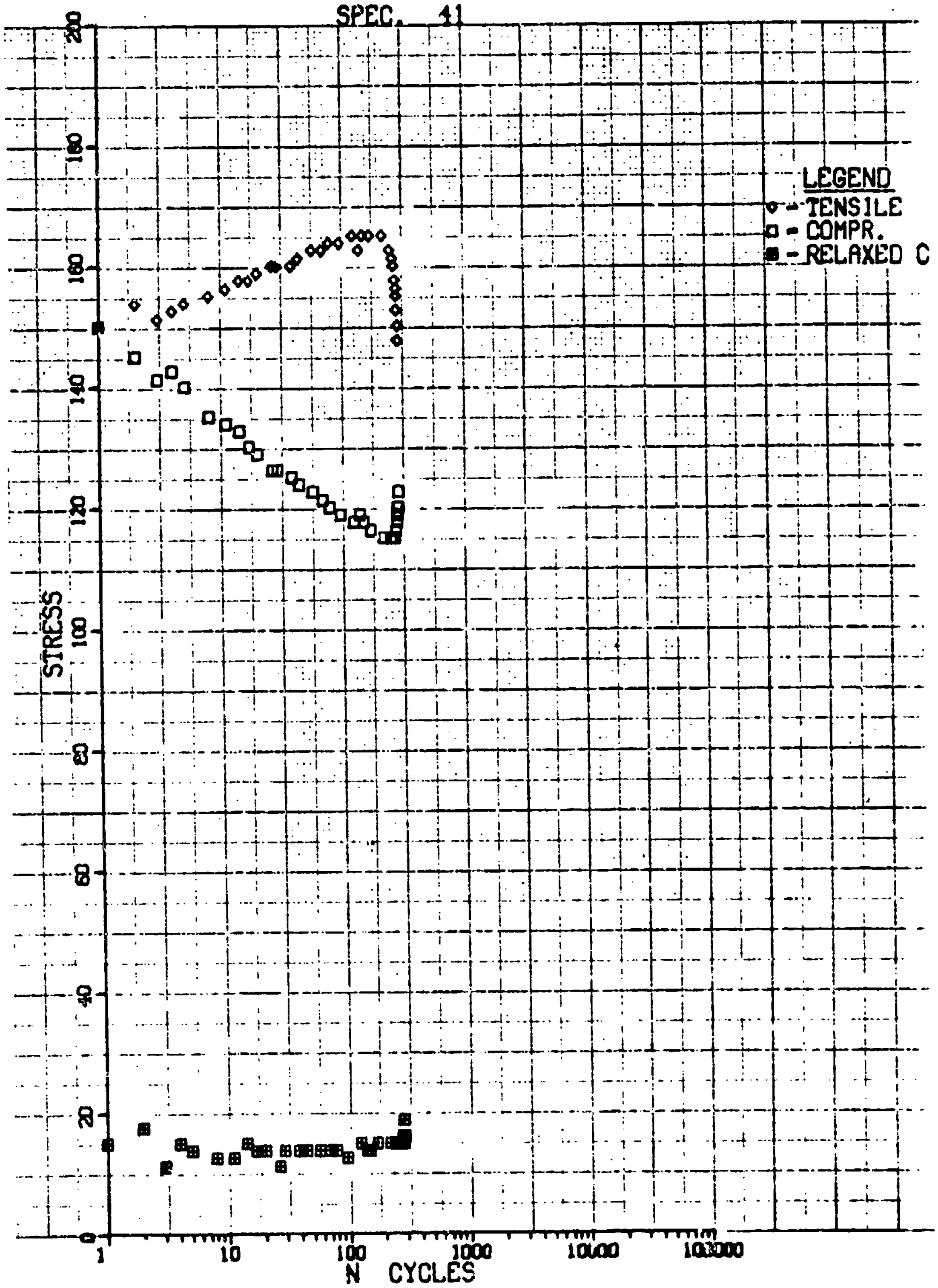

SPEC. 41
LEGEND
TENSILE
COMPR.
RELAXED C
STRESS
N CYCLES
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000

Figure 75.

TABLE 46

SPECIMEN 247

I	N	%N	PEAK TENSILE	HELD TENSILE	RELAXED TENSILE	PEAK COMPR.	HELD COMPR.	RELAXED COMPR.
1	1.	0.	****	0.	0.0	180.	161.	0.0
2	2.	1.	170.	0.	0.0	184.	168.	13.6
3	3.	1.	168.	0.	0.0	184.	167.	15.2
4	4.	2.	168.	0.	0.0	184.	167.	16.0
5	11.	4.	170.	0.	0.0	185.	163.	16.6
6	13.	5.	171.	0.	0.0	185.	163.	17.6
7	14.	5.	171.	0.	0.0	185.	162.	16.2
8	21.	8.	171.	0.	0.0	186.	161.	16.0
9	30.	11.	171.	0.	0.0	167.	160.	16.4
10	49.	19.	172.	0.	0.0	187.	159.	16.0
11	59.	22.	172.	0.	0.0	187.	158.	15.2
12	68.	26.	172.	0.	0.0	187.	157.	14.6
13	88.	33.	172.	0.	0.0	187.	157.	14.8
14	127.	48.	172.	0.	0.0	186.	156.	15.2
15	154.	59.	172.	0.	0.0	187.	156.	14.8
16	163.	62.	172.	0.	0.0	186.	156.	15.2
17	184.	70.	172.	0.	0.0	186.	156.	15.4
18	251.	95.	172.	0.	0.0	187.	156.	14.6
19	260.	99.	170.	0.	0.0	186.	156.	15.4
20	262.	100.	170.	0.	0.0	185.	157.	17.2

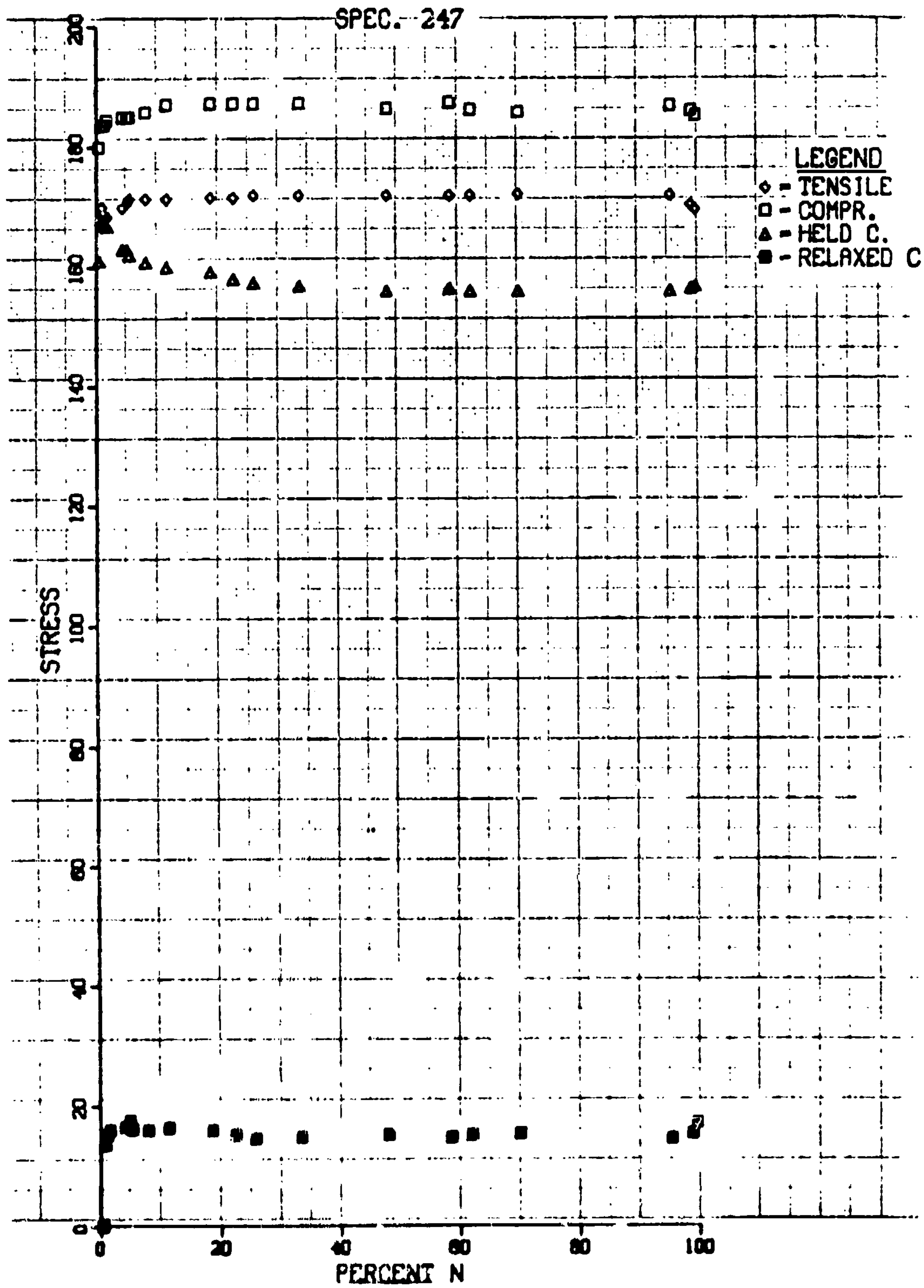
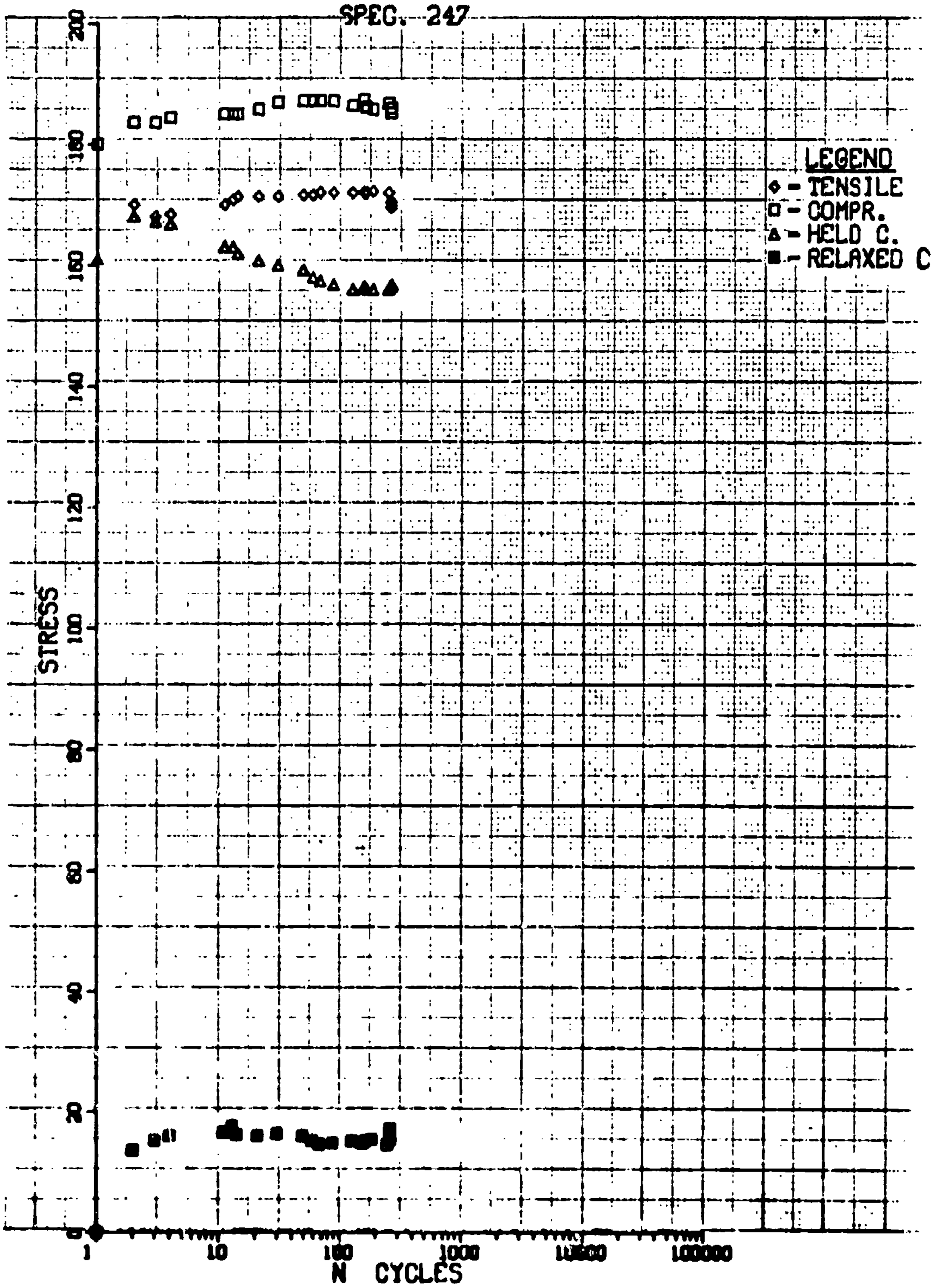

SPEC. 247
LEGEND
◇ - TENSILE
□ - COMPR.
▲ - HELD C.
■ - RELAXED C
STRESS
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
PERCENT N

Figure 76.



SPEC. 247
LEGEND
◇ - TENSILE
□ - COMPR.
△ - HELD C.
■ - RELAXED C
STRESS
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
100000
N CYCLES

Figure 77.

SECTION 11

RENÉ 95 TENSILE AND COMPRESSIVE STRAIN-HOLD TESTS

Tables 47 through 59 and Figures 78 through 103 present data on the tensile and compressive strain-hold tests on René 95. Equal and unequal hold periods of one and ten minutes were used.

TABLE 47

SPECIMEN 1

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			---------STRESSES-------			
1	1.	1.	178.	10.0	191.	13.3
2	2.	1.	180.	18.0	194.	16.3
3	3.	2.	181.	22.5	195.	18.0
4	6.	4.			197.	19.5
5	7.	4.	182.	24.5	197.	20.8
6	12.	8.	184.	27.3	198.	21.8
7	16.	10.	183.	27.5	199.	23.8
8	17.	11.	183.	30.0	200.	22.5
9	18.	12.	183.	27.5	200.	
10	26.	17.	183.	28.0	198.	21.8
11	36.	23.	183.	27.5	199.	23.8
12	41.	26.	183.	28.8	199.	18.8
13	46.	29.	183.	31.3	200.	23.8
14	67.	43.	183.	30.5	198.	
15	80.	51.	181.	28.8	196.	22.5
16	106.	68.	180.	31.3	196.	24.2
17	115.	74.	178.	27.5	196.	20.5
18	116.	74.	179.	27.8	196.	24.2
19	134.	86.	178.	27.5	193.	20.0
20	135.	87.	178.	30.0	194.	23.8
21	136.	87.	178.	31.8	195.	
22	140.	90.	176.	27.5	194.	20.0
23	145.	93.	177.	29.0	193.	22.5
24	150.	96.	176.	31.3	194.	25.0
25	154.	99.	176.	31.0	195.	25.0
26	155.	99.	176.	31.0	195.	21.3

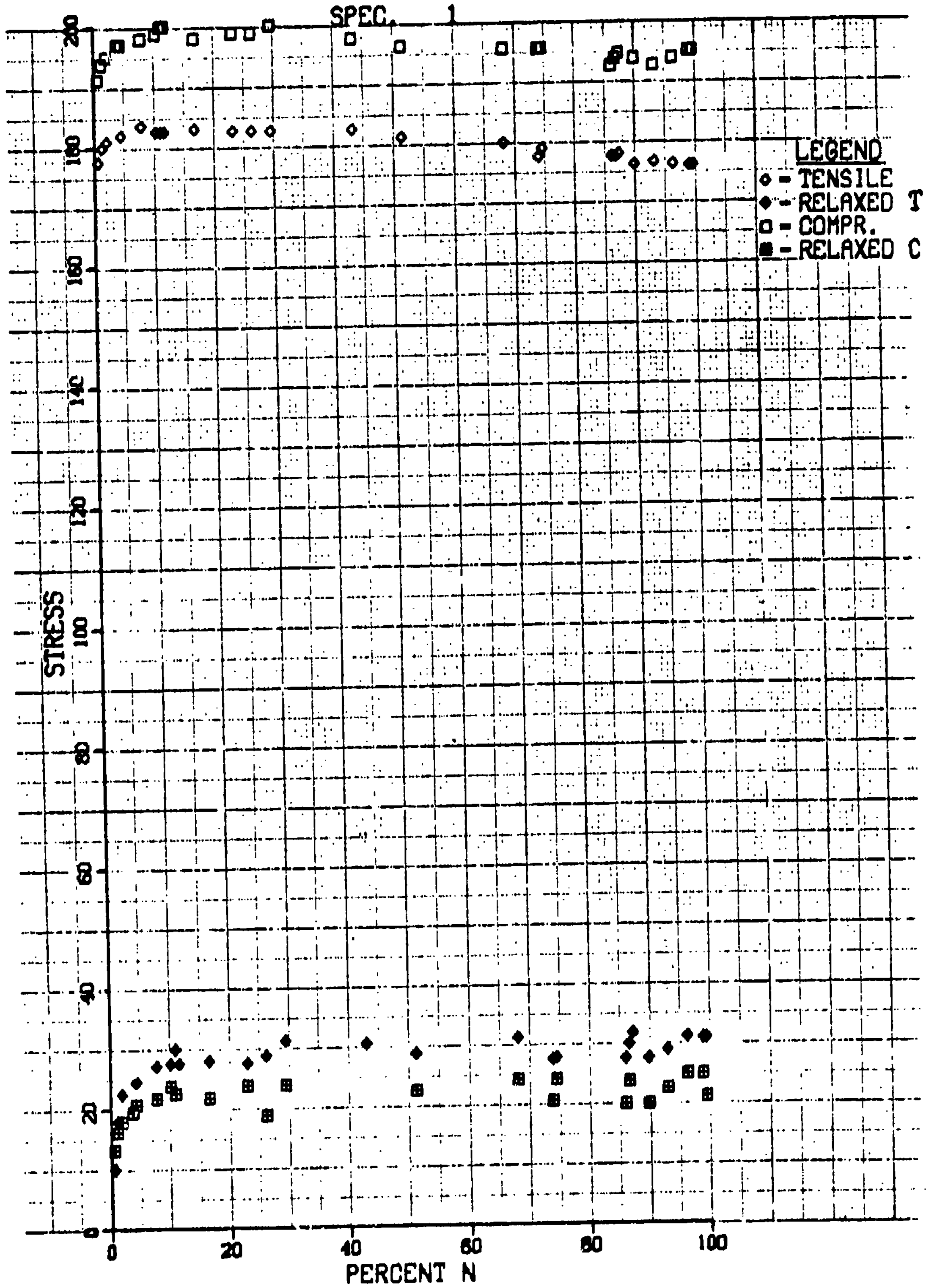

SPEC. 1
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
▣ - RELAXED C
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 78.

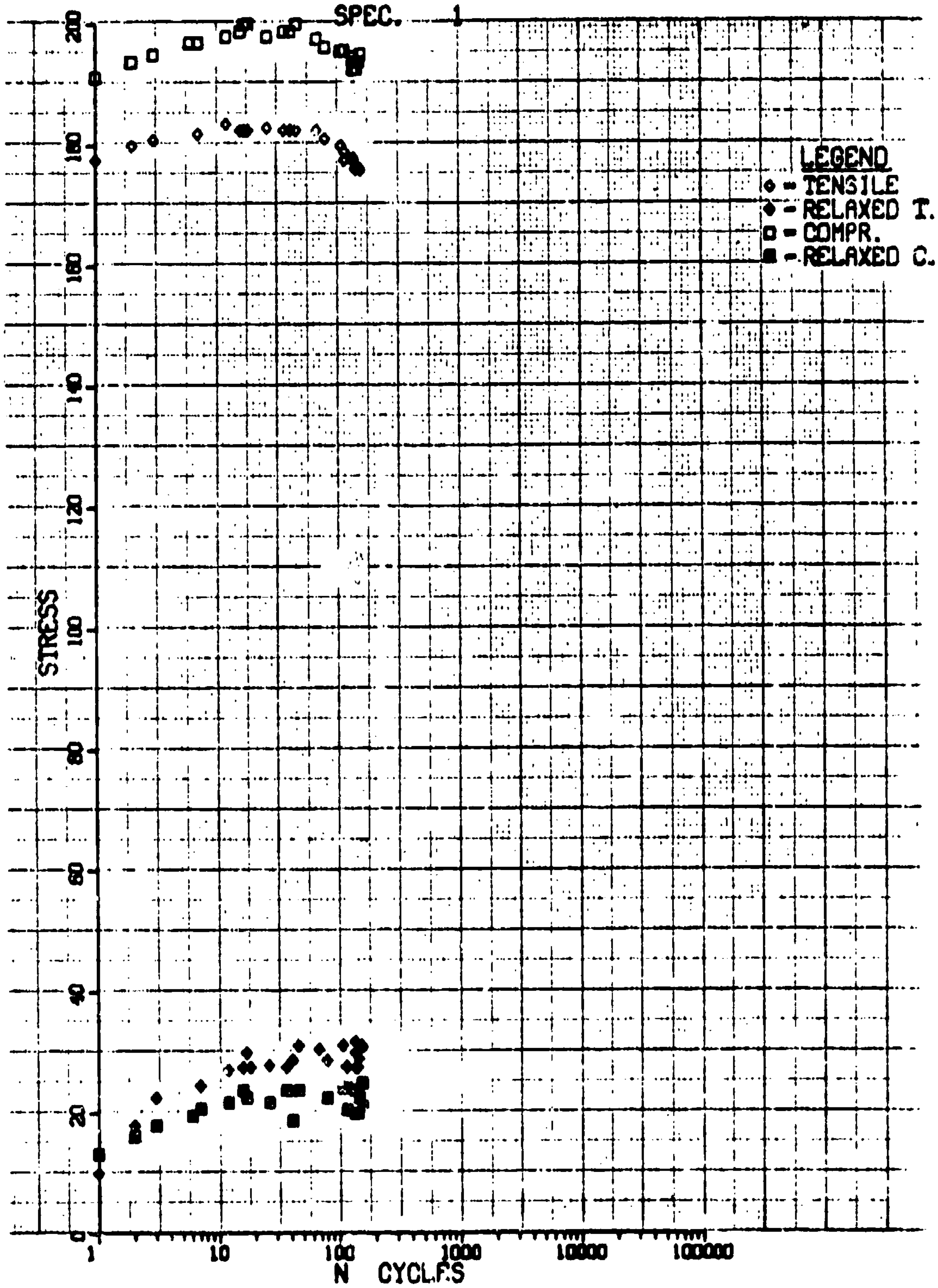

SPEC. 1
LEGEND
◇ = TENSILE
◆ = RELAXED T.
□ = COMPR.
■ = RELAXED C.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 79.

TABLE 48

SPECIMEN 2

			STRESSES			
I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	173.	6.5	182.	11.5
2	2.	1.	173.	8.8	180.	6.3
3	3.	1.	174.	12.5	182.	7.7
4	13.	5.	174.	18.8	186.	13.8
5	24.	10.	174.	20.0	185.	11.3
6	33.	14.	173.	20.0	187.	12.0
7	49.	21.	173.	17.5	186.	13.0
8	63.	26.	171.	18.8	188.	16.3
9	107.	45.	170.	18.8	185.	12.5
10	132.	55.	170.	18.8	183.	12.5
11	147.	62.	169.	18.8	184.	16.3
12	198.	83.	166.	20.0	183.	
13	211.	89.	165.	20.0	184.	15.0
14	227.	95.	165.	20.0	180.	13.8
15	231.	97.	165.	17.5	180.	13.8
16	236.	99.	168.	20.0	181.	15.0

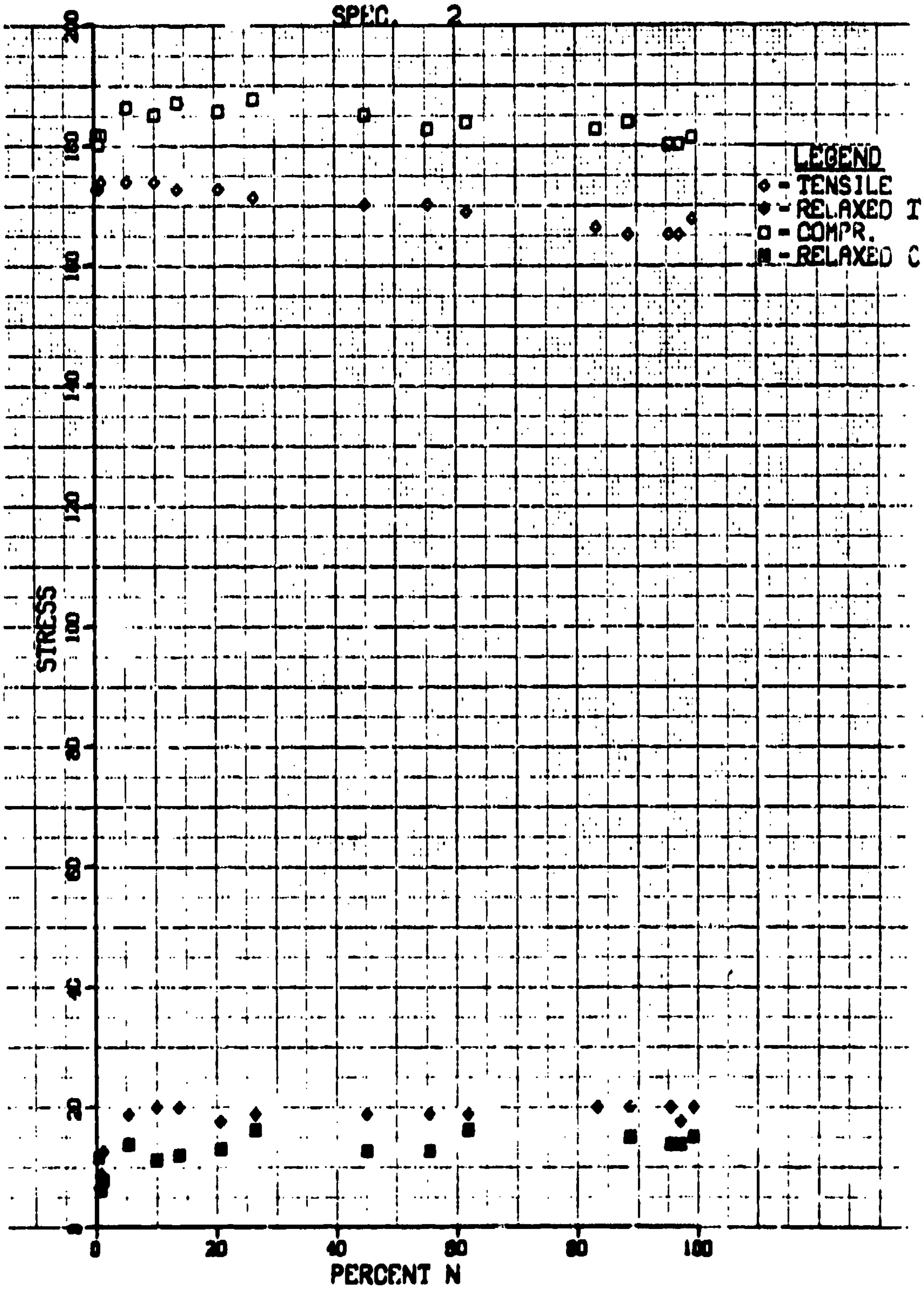

SPEC. 2
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
■ - RELAXED C
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 80.

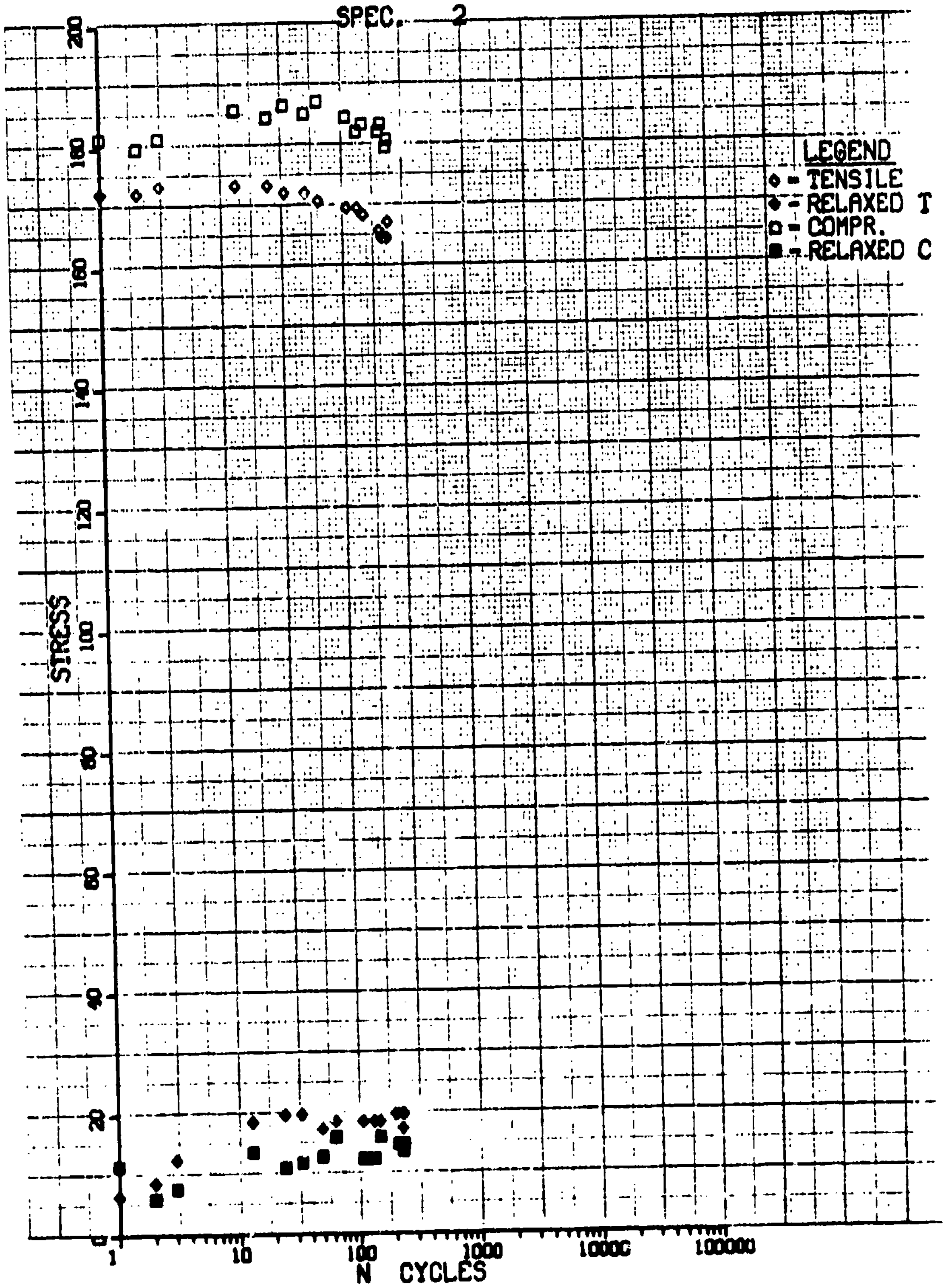
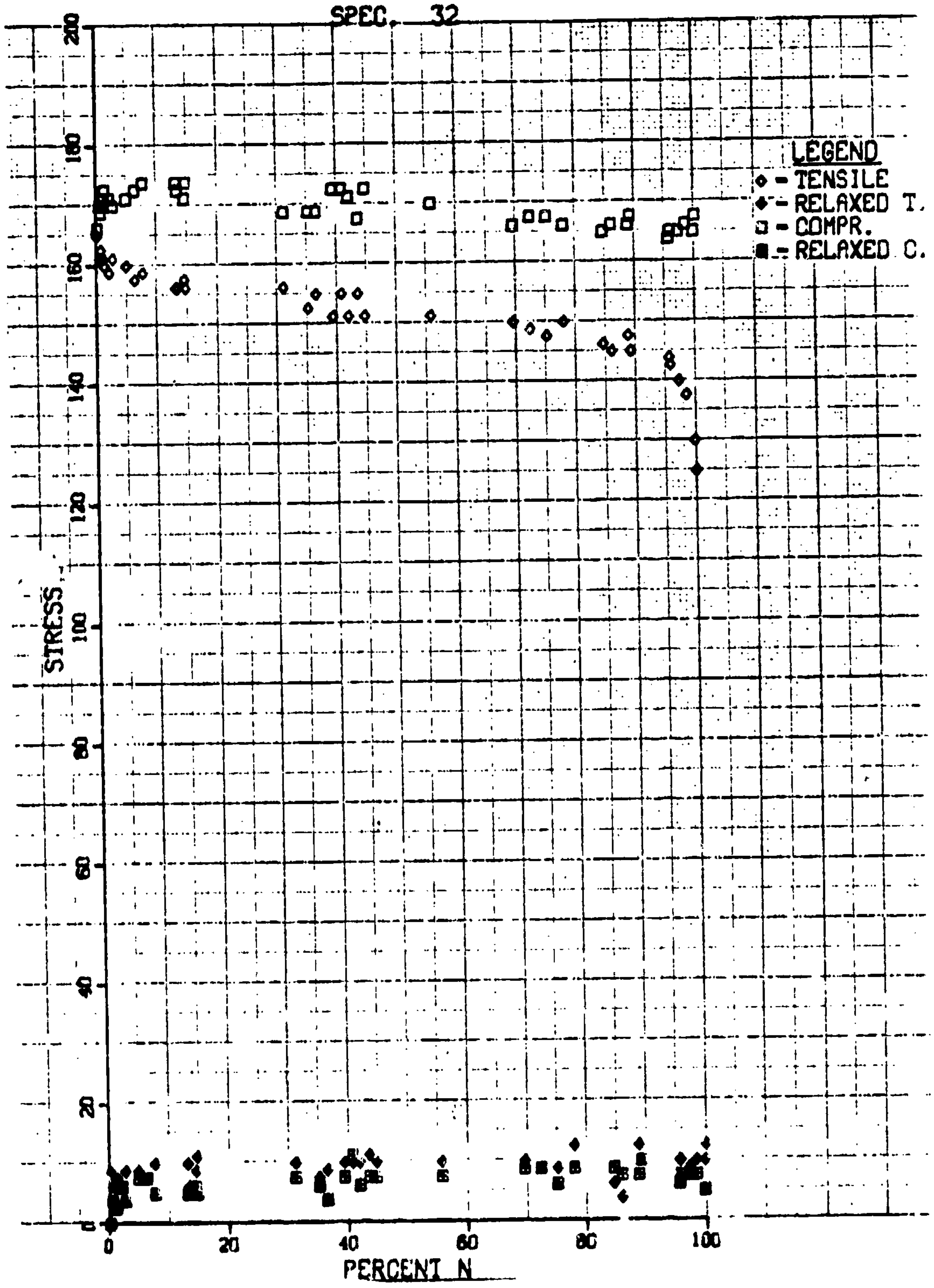

SPEC. 2
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
■ - RELAXED C
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 81.

TABLE 49

SPECIMEN 32

			---------	STRESSES	-------	
I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	165.	8.8	166.	0.0
2	2.	1.	161.	3.8	170.	3.8
3	3.	1.	163.	6.3	169.	2.5
4	4.	1.	161.	7.5	171.	2.5
5	5.	1.	160.	7.5	173.	6.3
6	8.	2.	159.	6.3	171.	6.3
7	10.	3.	161.	8.8	170.	3.8
8	18.	5.	160.	8.8	171.	7.5
9	23.	6.	158.	7.5	173.	7.5
10	28.	8.	159.	10.0	174.	5.0
11	47.	13.	156.	10.0	174.	5.0
12	48.	13.	156.	6.3	173.	
13	52.	15.	158.	8.8	171.	6.3
14	53.	15.	156.	11.3	174.	5.0
15	112.	31.	156.	10.0	169.	7.5
16	126.	35.	153.	7.5	169.	6.3
17	131.	37.	155.	8.8	169.	3.8
18	141.	39.	151.	10.0	173.	7.5
19	146.	41.	155.	10.0	173.	11.3
20	150.	42.	151.	10.0	171.	6.3
21	156.	44.	155.	11.3	168.	7.5
22	160.	45.	151.	10.0	173.	7.5
23	200.	56.	151.	10.0	170.	7.5
24	249.	70.	150.	10.0	166.	8.8
25	259.	72.	149.	8.8	168.	8.8
26	269.	75.	148.	8.8	168.	6.3
27	279.	78.	150.	12.5	166.	8.8
28	303.	85.	146.	6.3	165.	8.8
29	308.	86.	145.	3.8	166.	7.5
30	318.	89.	148.	12.5	166.	7.5
31	319.	89.	145.	10.0	168.	10.0
32	342.	96.	144.	10.0	164.	6.3
33	343.	96.	143.	10.0	165.	7.5
34	348.	97.	140.	8.8	165.	7.5
35	352.	98.	138.	10.0	166.	7.5
36	357.	100.	130.	10.0	165.	5.0
37	358.	100.	125.	12.5	168.	



SPEC. 32
LEGEND
◇ - TENSILE
◆ - RELAXED T.
□ - COMPR.
■ - RELAXED C.
STRESS
200
180
160
140
120
100
80
60
40
20
0
0
20
40
60
80
100
PERCENT N

Figure 82.

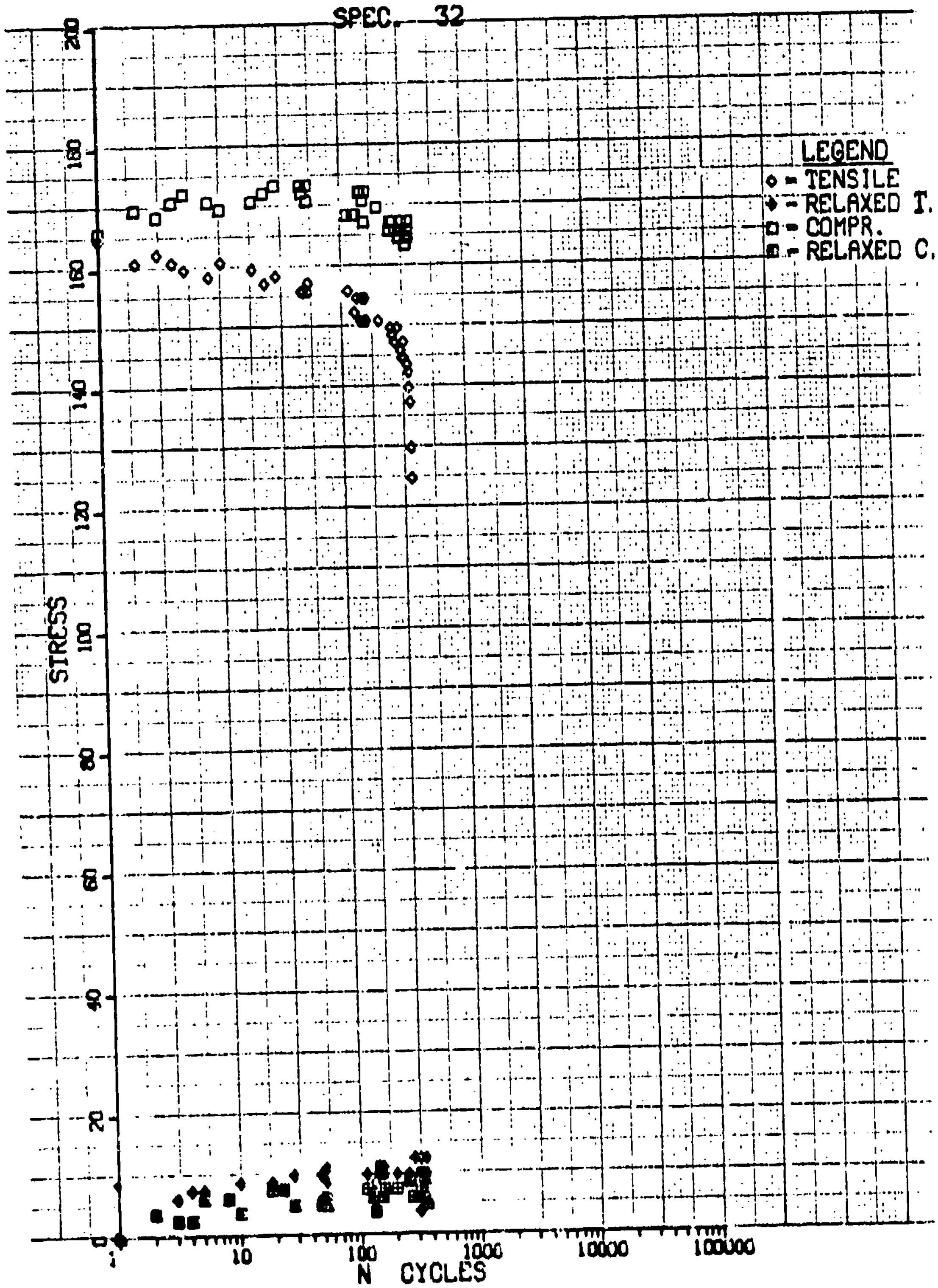

SPEC. 32
LEGEND
◇ - TENSILE
◆ - RELAXED T.
□ - COMPR.
▣ - RELAXED C.
STRESS
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
100000
N CYCLES

Figure 83.

TABLE 50

SPECIMEN 9

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	145.	2.5	154.	0.0
2	2.	0.	143.	1.3	154.	1.3
3	3.	0.	143.	2.5	155.	3.8
4	4.	0.	144.	3.8	153.	1.3
5	10.	1.	141.	5.0	156.	2.5
6	18.	2.	141.	6.3	158.	2.5
7	20.	2.	138.	3.8	158.	2.5
8	25.	3.	140.	7.5	158.	2.5
9	26.	3.	136.	5.0	160.	3.8
10	40.	4.	135.	2.5	159.	3.8
11	100.	10.	135.	6.3	160.	5.0
12	150.	16.	138.	7.5	156.	5.0
13	173.	18.	135.	8.8	161.	6.3
14	188.	20.	138.	7.5	158.	6.3
15	219.	23.	135.	7.5	159.	6.3
16	350.	36.	134.	6.3	155.	2.5
17	475.	50.	135.	8.8	155.	6.3
18	549.	57.	133.	5.0	153.	3.8
19	675.	70.	130.	5.0	153.	2.5
20	725.	76.	133.	7.5	150.	5.0
21	770.	80.	130.	6.3	150.	5.0
22	800.	83.	130.	8.8	151.	3.8
23	830.	87.	128.	6.3	150.	2.5
24	845.	88.	125.	5.0	153.	5.0
25	875.	91.	125.	8.8	153.	5.0
26	897.	94.	125.	7.5	149.	5.0
27	925.	96.	120.	7.5	150.	6.3
28	932.	97.	120.	10.0	150.	7.5
29	940.	98.	115.	6.3	150.	7.5
30	947.	99.	108.	7.5	153.	7.5
31	948.	99.	108.	8.8	151.	6.3
32	949.	99.	106.	7.5	150.	7.5
33	954.	99.	94.	8.8	148.	7.5

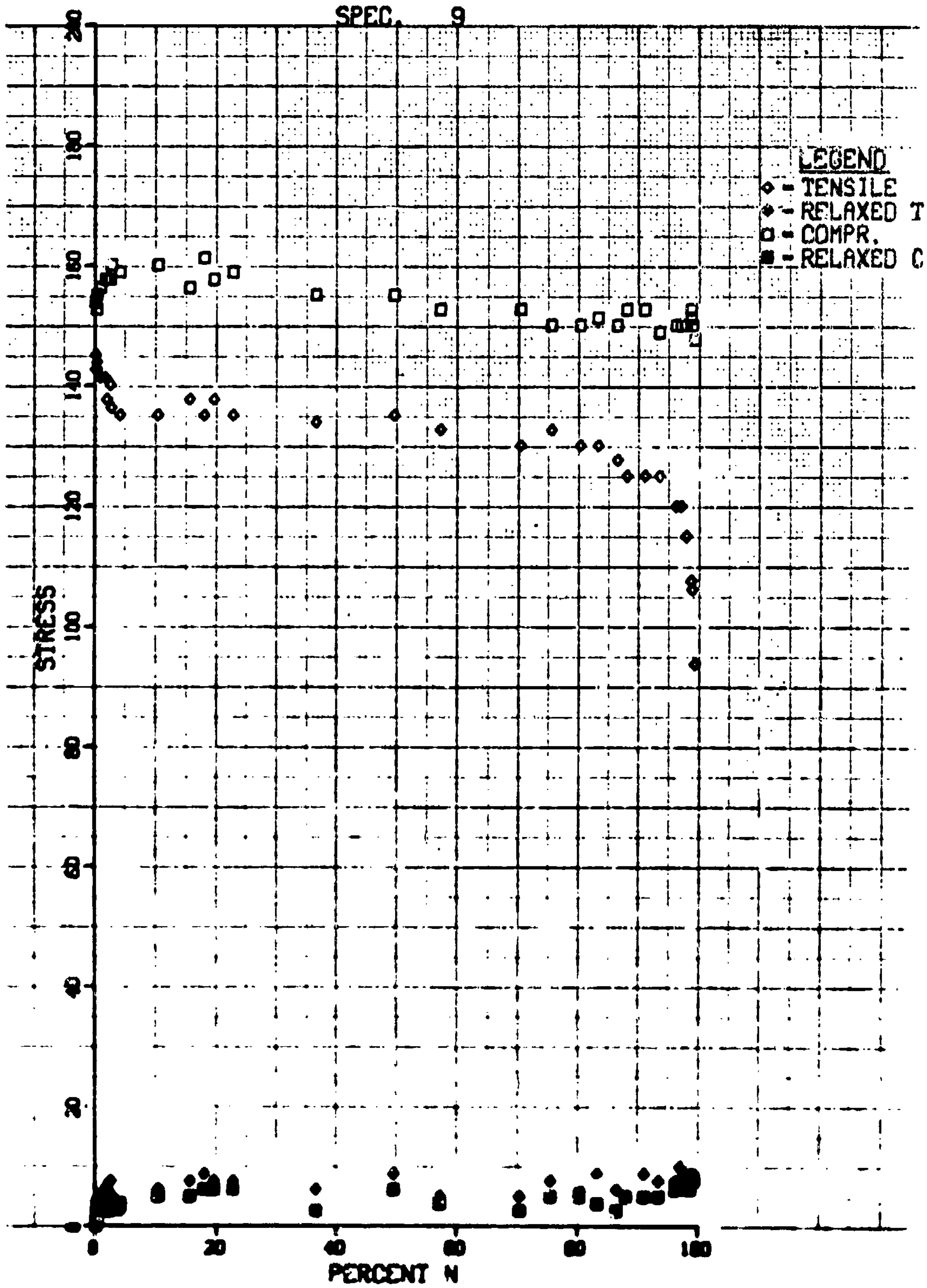

SPEC. 9
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
■ - RELAXED C
STRESS
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80
100
PERCENT N

Figure 84.

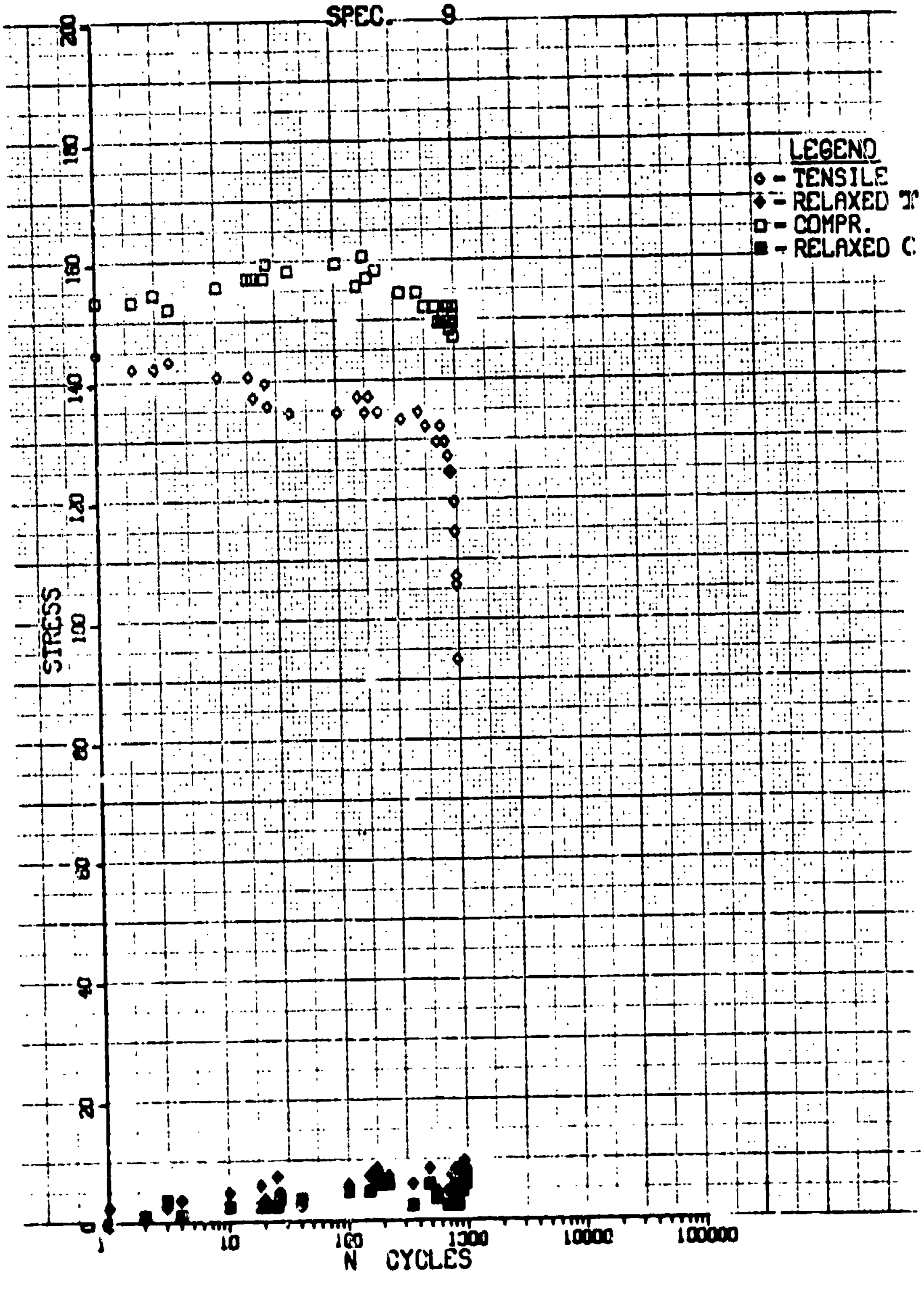

SPEC. 9
LEGEND
- TENSILE
- RELAXED T
- COMPR.
- RELAXED C
STRESS
N CYCLES
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
100000

Figure 85.

TABLE 51

SPECIMEN 4

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			--------STRESSES-------			
1	1.	0.	133.	3.8	131.	0.0
2	2.	0.	132.	3.2	133.	2.5
3	3.	0.	133.	5.0	134.	4.0
4	4.	0.	133.	6.3	135.	5.0
5	7.	1.	130.	3.8	135.	5.0
6	15.	1.	128.	5.0	135.	5.0
7	24.	2.	126.	5.0	135.	3.8
8	46.	4.	125.	5.0	137.	4.0
9	103.	8.	124.	6.3	138.	6.3
10	220.	18.	123.	6.3	138.	6.3
11	305.	25.	121.	6.3	136.	5.0
12	436.	36.	120.	6.0	136.	7.3
13	525.	43.	120.	6.3	135.	7.5
14	600.	49.	120.	7.5	135.	7.5
15	690.	57.	119.	7.5	135.	7.5
16	755.	62.	118.	6.3	134.	7.5
17	805.	66.	118.	7.5	134.	7.5
18	850.	70.	118.	7.5	133.	7.5
19	915.	75.	116.	6.3	133.	7.5
20	945.	78.	116.	7.5	133.	7.5
21	995.	82.	116.	8.8	133.	8.8
22	1049.	86.	115.	7.5	131.	7.5
23	1075.	88.	115.	8.8	131.	7.5
24	1115.	92.	114.	7.5	130.	7.5
25	1123.	92.	113.	7.5	130.	7.5
26	1145.	94.	111.	8.8	130.	8.8
27	1153.	95.	110.	8.8	130.	8.8
28	1165.	96.	108.	7.5	130.	8.8
29	1173.	97.	106.	7.5	130.	8.8
30	1180.	97.	105.	7.5	130.	8.8
31	1182.	97.	104.	7.5	130.	8.8
32	1188.	98.	101.	7.3	130.	8.8
33	1195.	98.	100.	8.8	130.	8.8
34	1197.	99.	98.	7.5	130.	8.8
35	1202.	99.	95.	7.5	130.	8.8
36	1205.	99.	91.	6.3	129.	7.5
37	1212.	100.	85.	6.3	130.	8.8

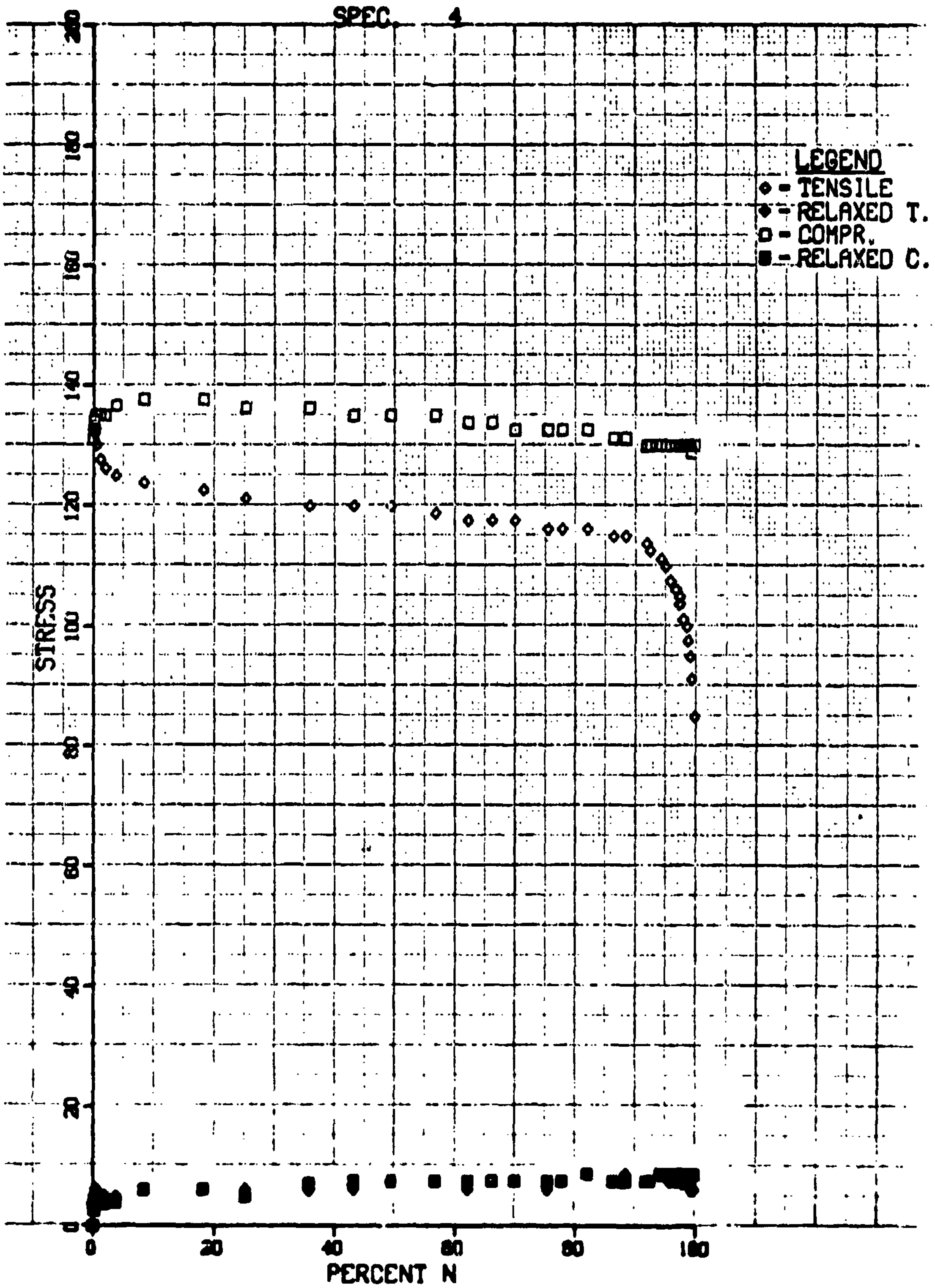
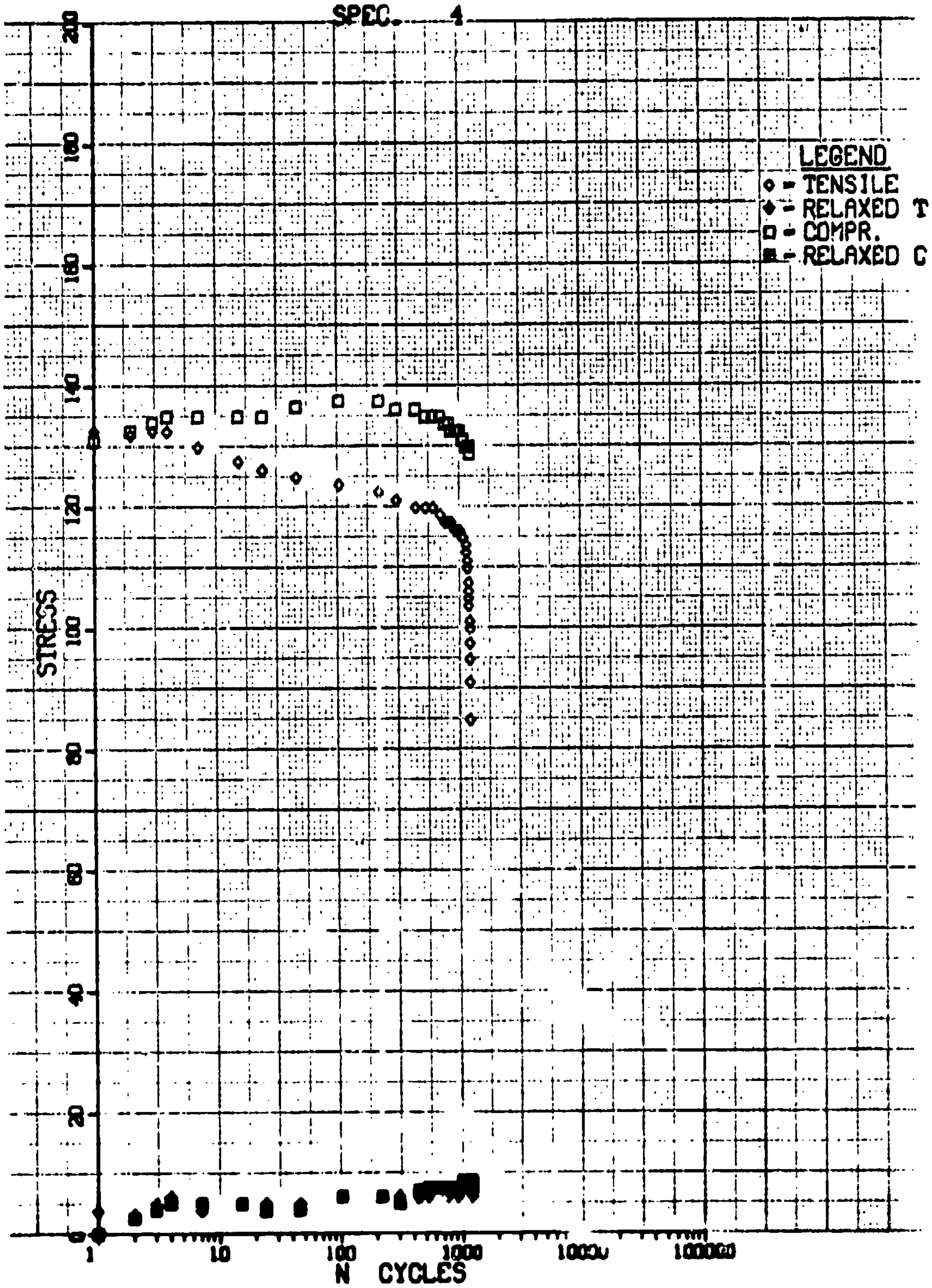

SPEC. 4
LEGEND
◇ - TENSILE
◆ - RELAXED T.
□ - COMPR.
■ - RELAXED C.
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 86.



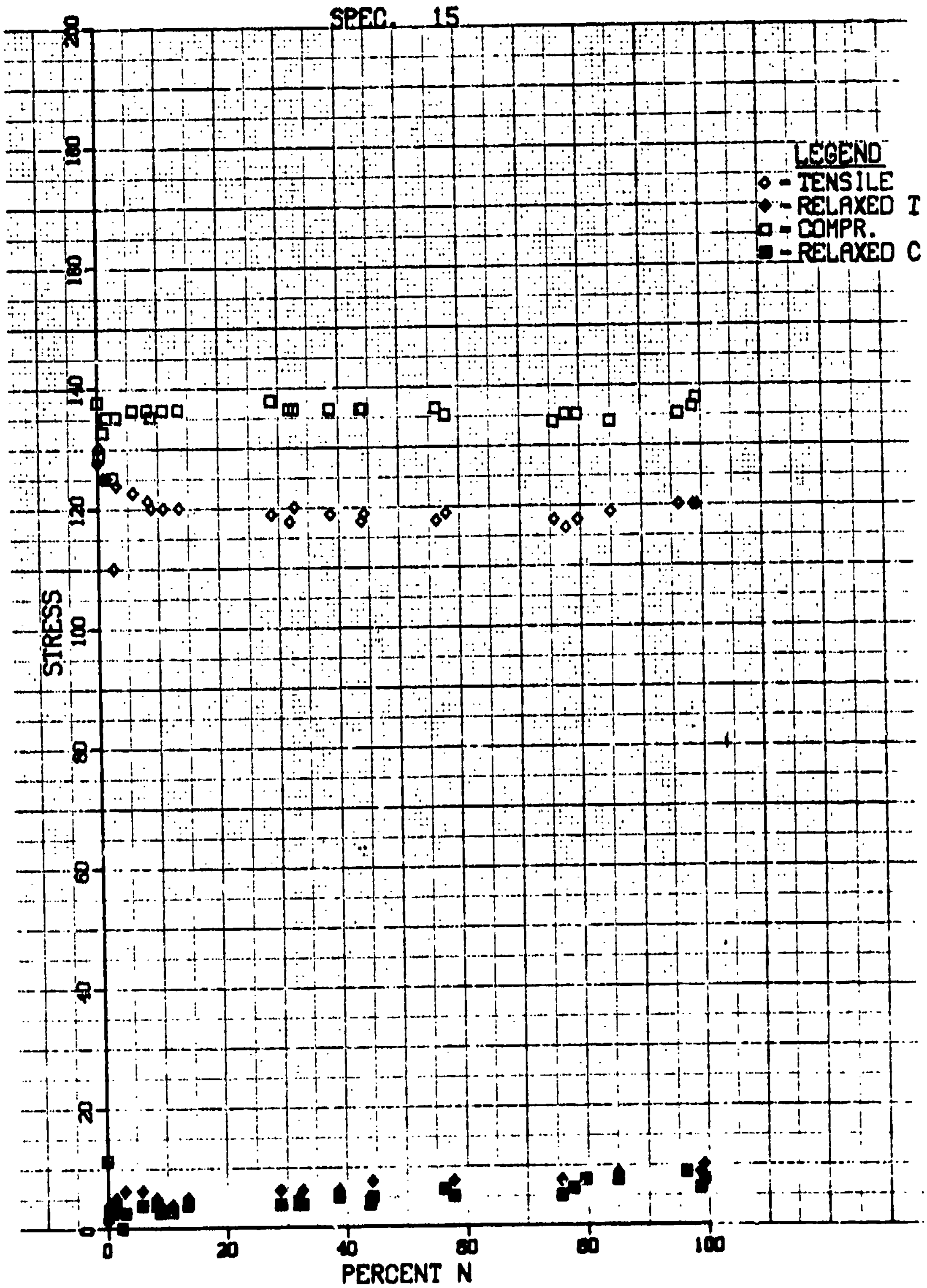
SPEC. 4
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
■ - RELAXED C
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 87.

TABLE 52

SPECIMEN 15

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	128.	1.3	138.	11.3
2	2.	0.	130.	3.8	129.	2.5
3	3.	0.	130.	3.8	129.	2.5
4	9.	1.	125.	3.8	133.	2.5
5	10.	1.	125.	2.5	133.	2.5
6	11.	1.	125.	3.8	133.	2.5
7	18.	1.	125.	5.0	135.	3.8
8	31.	2.	110.	0.0	125.	0.0
9	39.	3.	124.	6.3	135.	2.5
10	75.	6.	123.	6.3	136.	3.8
11	105.	8.	121.	5.0	136.	3.8
12	112.	9.	120.	3.8	135.	2.5
13	140.	11.	120.	3.8	136.	2.5
14	173.	13.	120.	5.0	136.	3.8
15	370.	29.	119.	6.3	138.	3.8
16	410.	32.	118.	5.0	136.	3.8
17	420.	33.	120.	6.3	136.	3.8
18	498.	39.	119.	6.3	136.	5.0
19	563.	44.	118.	5.0	136.	3.8
20	569.	44.	119.	7.5	136.	5.0
21	725.	56.	118.	6.3	136.	6.3
22	745.	58.	119.	7.5	135.	5.0
23	974.	76.	118.	7.5	134.	5.0
24	1000.	78.	116.	6.3	135.	6.3
25	1025.	80.	118.	7.5	135.	7.5
26	1095.	85.	119.	8.8	134.	7.5
27	1240.	96.	120.	8.8	135.	8.8
28	1270.	99.	120.	8.8	136.	6.3
29	1278.	99.	120.	10.0	138.	7.5



SPEC. 15
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
■ - RELAXED C
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 88.

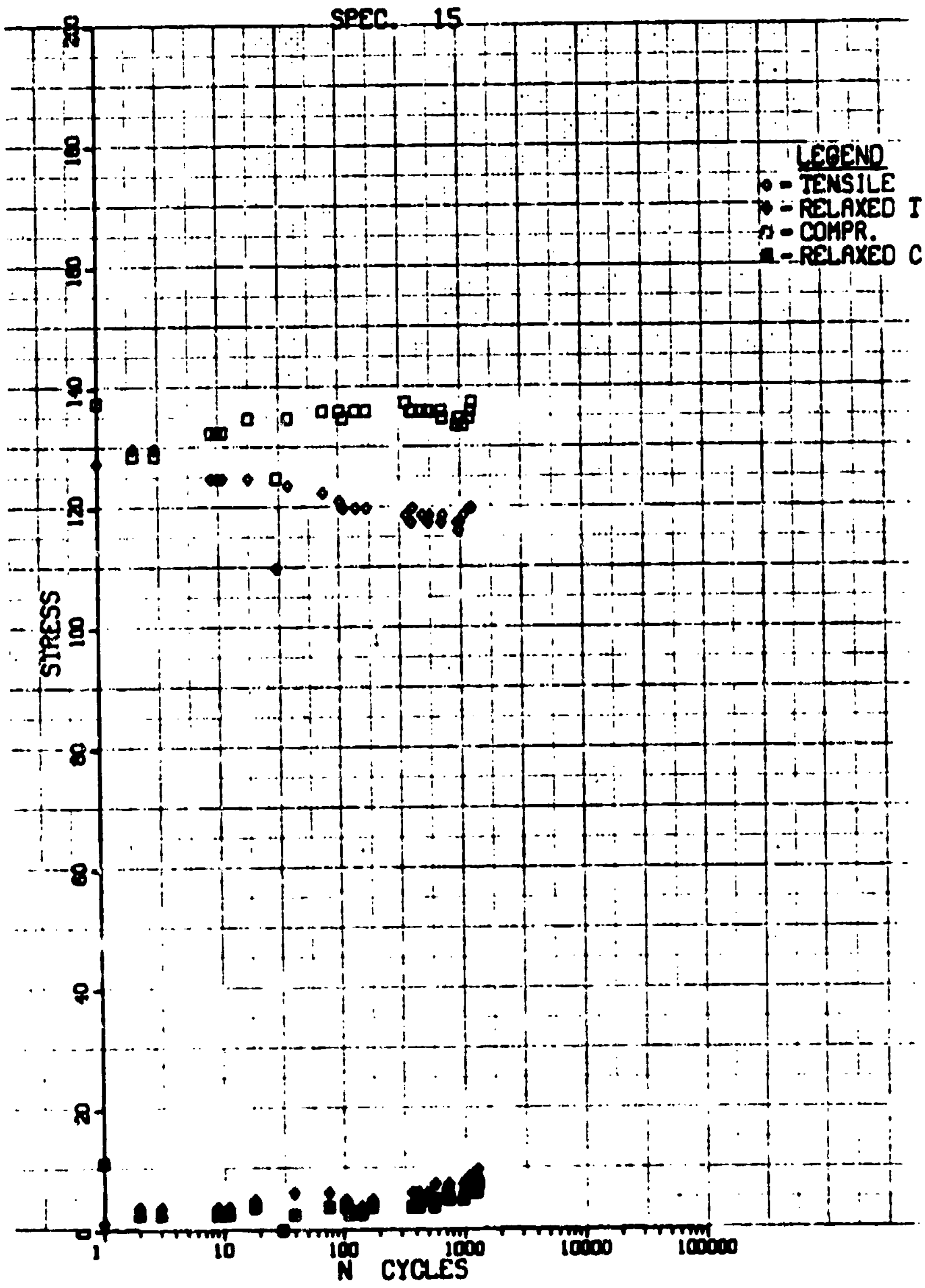

SPEC. 15
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
■ - RELAXED C
STRESS
200
180
160
140
120
100
80
60
40
20
1
10
100
1000
10000
100000
N CYCLES

Figure 89.

TABLE 53

SPECIMEN 229

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	100.	0.0	****	****
2	2.	0.	103.	-1.0	109.	-2.0
3	3.	0.	105.	0.0	111.	-2.0
4	4.	0.	104.	-1.0	113.	-2.0
5	5.	0.	108.	-2.0	116.	-1.0
6	6.	0.	108.	-2.0	116.	-1.0
7	13.	0.	109.	0.0	117.	-1.0
8	14.	0.	107.	0.0	118.	0.0
9	15.	0.	108.	0.0	116.	-1.0
10	23.	0.	108.	0.0	117.	-1.0
11	33.	1.	107.	0.0	118.	-2.0
12	34.	1.	106.	0.0	119.	-1.0
13	35.	1.	105.	0.0	120.	0.0
14	43.	1.	107.	0.0	118.	-2.0
15	52.	1.	104.	0.0	120.	0.0
16	72.	1.	104.	0.0	121.	0.0
17	131.	2.	102.	0.0	122.	-1.0
18	202.	4.	102.	0.0	123.	0.0
19	291.	6.	101.	0.0	124.	0.0
20	460.	9.	100.	0.0	125.	0.0
21	580.	11.	99.	0.0	122.	0.0
22	1235.	23.	98.	0.0	124.	0.0
23	1236.	23.	96.	0.0	124.	0.0
24	1255.	24.	98.	0.0	124.	0.0
25	1512.	29.	100.	0.0	126.	0.0
26	1695.	32.	105.	0.0	120.	0.0
27	1701.	32.	99.	0.0	125.	0.0
28	2160.	41.	98.	0.0	126.	0.0
29	2177.	41.	97.	0.0	127.	0.0
30	2199.	42.	99.	0.0	125.	0.0
31	2435.	46.	102.	0.0	121.	0.0
32	2505.	47.	103.	0.0	120.	0.0
33	2552.	48.	100.	0.0	124.	0.0
34	2575.	49.	96.	0.0	128.	0.0
35	2577.	49.	101.	0.0	127.	0.0
36	2625.	50.	94.	0.0	129.	0.0
37	3820.	72.	96.	0.0	126.	0.0
38	4101.	78.	96.	0.0	128.	0.0
39	4122.	78.	93.	0.0	129.	0.0
40	4123.	78.	92.	0.0	130.	0.0
41	4150.	79.	94.	0.0	128.	0.0
42	4649.	88.	91.	0.0	130.	0.0
43	4748.	90.	92.	0.0	128.	0.0
44	4755.	90.	90.	0.0	131.	0.0
45	4905.	91.	90.	0.0	130.	0.0
46	4934.	93.	89.	0.0	129.	0.0
47	4951.	94.	88.	0.0	132.	0.0
48	5075.	96.	87.	0.0	132.	0.0
49	5151.	98.	86.	0.0	132.	0.0
50	5183.	98.	88.	3.0	132.	1.0
51	5214.	99.	85.	1.0	132.	0.0
52	5225.	99.	84.	0.0	133.	0.0
53	5240.	99.	88.	0.0	131.	0.0
54	5249.	99.	93.	0.0	132.	0.0
55	5258.	100.	103.	0.0	132.	0.0
56	5259.	100.	104.	0.0	132.	0.0
57	5260.	100.	105.	2.0	134.	0.0
58	5261.	100.	107.	0.0	****	****
59	5269.	100.	117.	5.0	145.	3.0

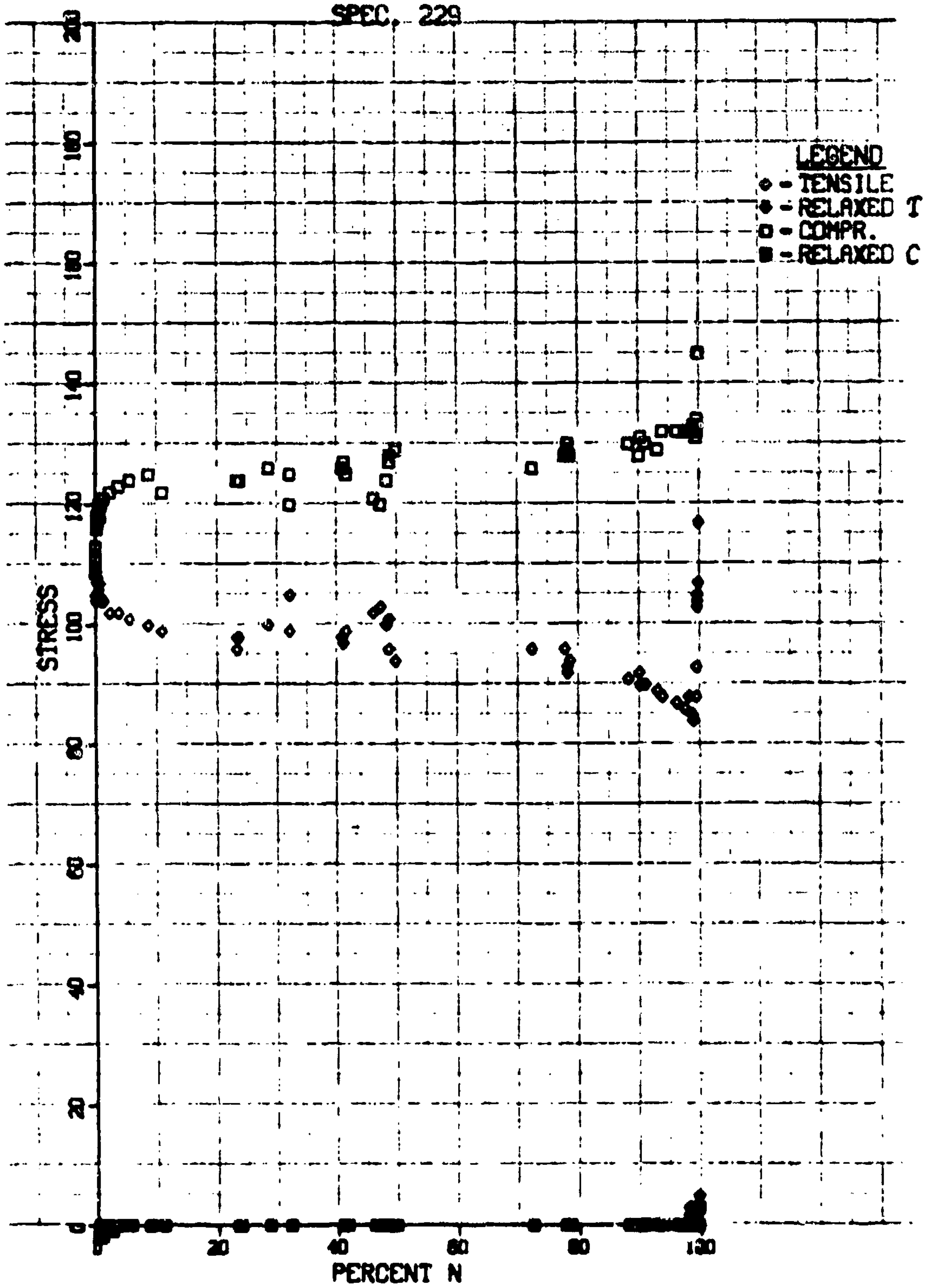
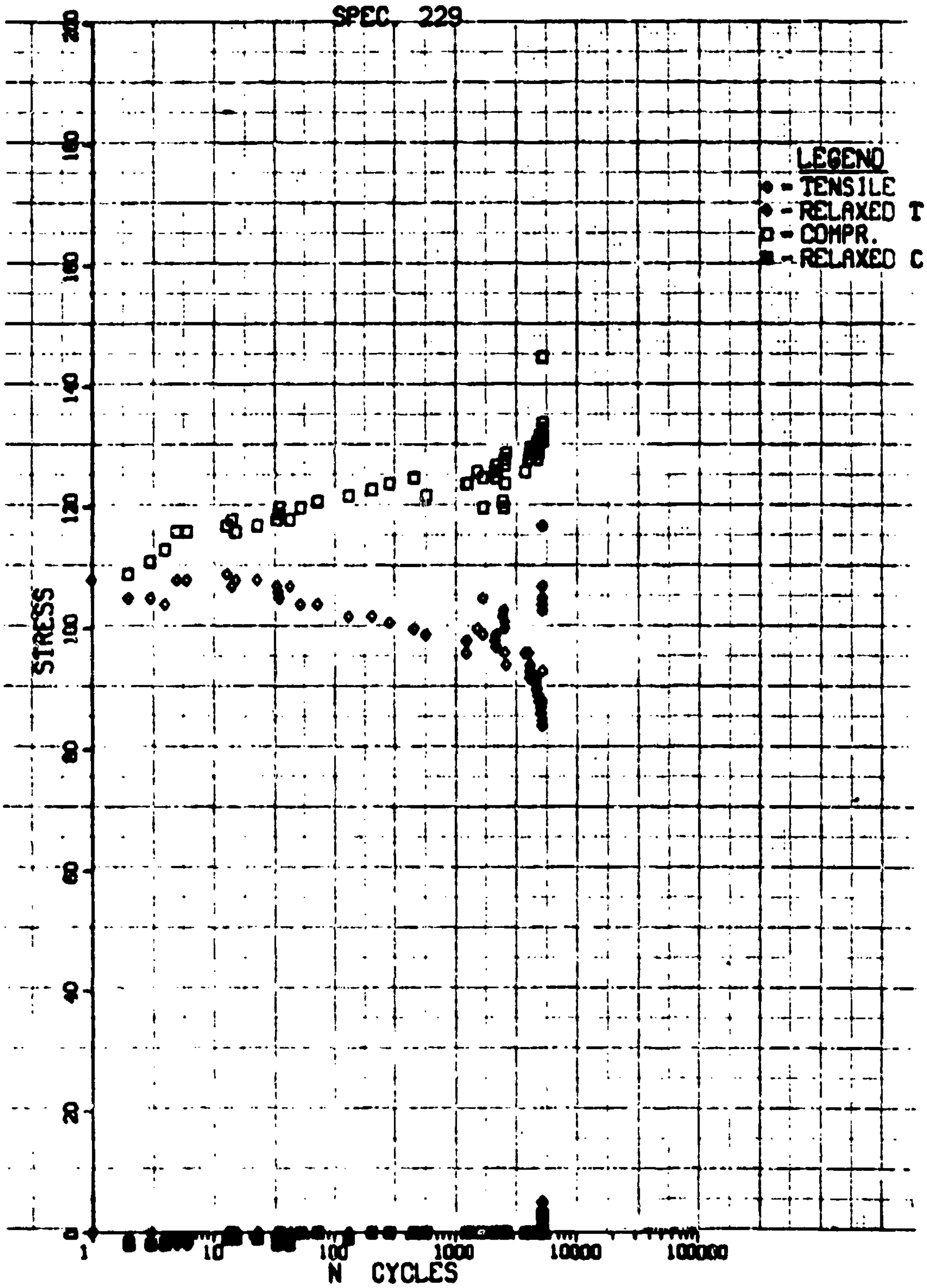

SPEC. 229
LEGEND
TENSILE
RELAXED T
COMPR.
RELAXED C
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 90.



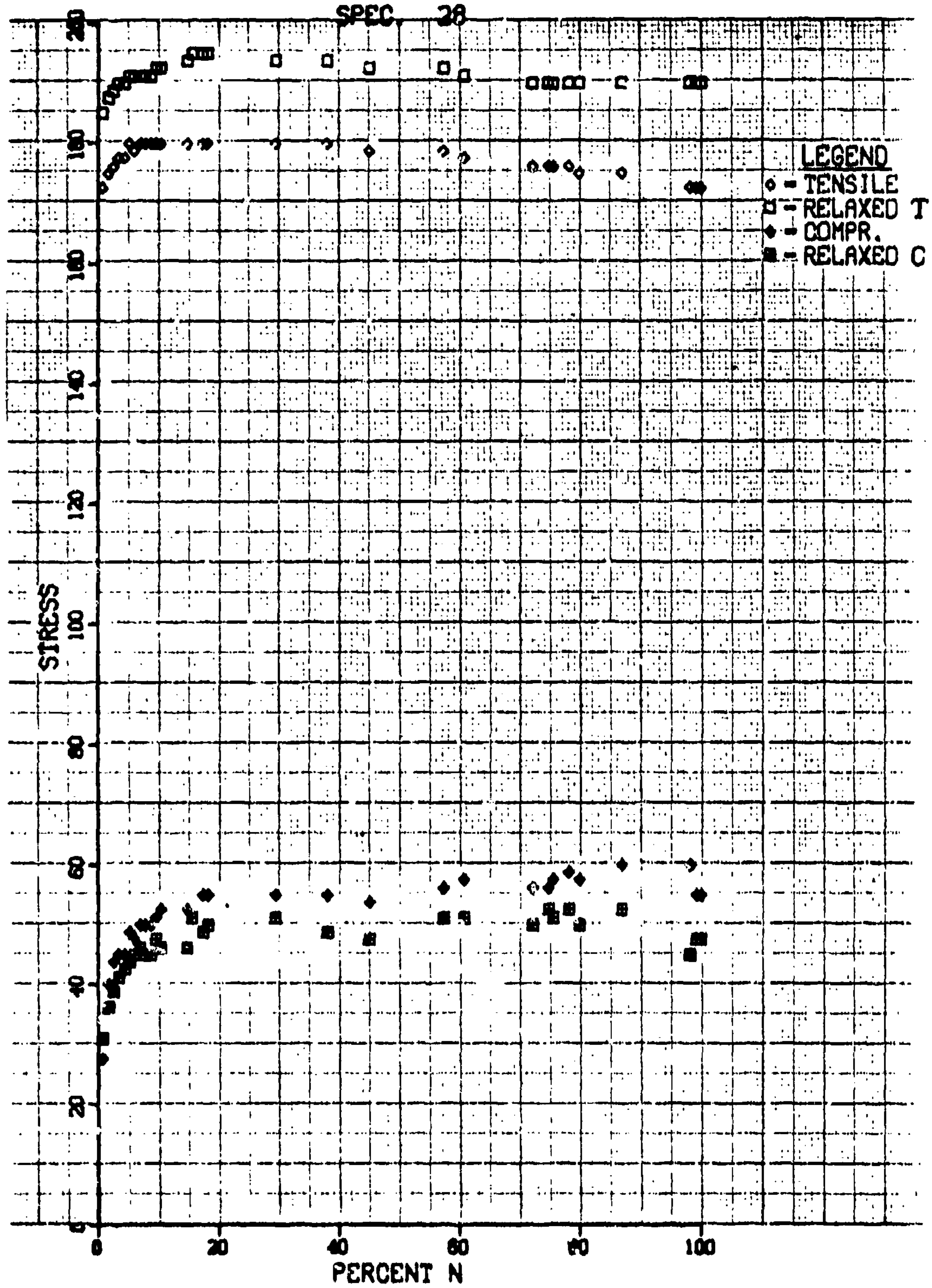
SPEC. 229
LEGEND
- TENSILE
- RELAXED T
- COMPR.
- RELAXED C
STRESS
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
100000
N CYCLES

Figure 91.

TABLE 54

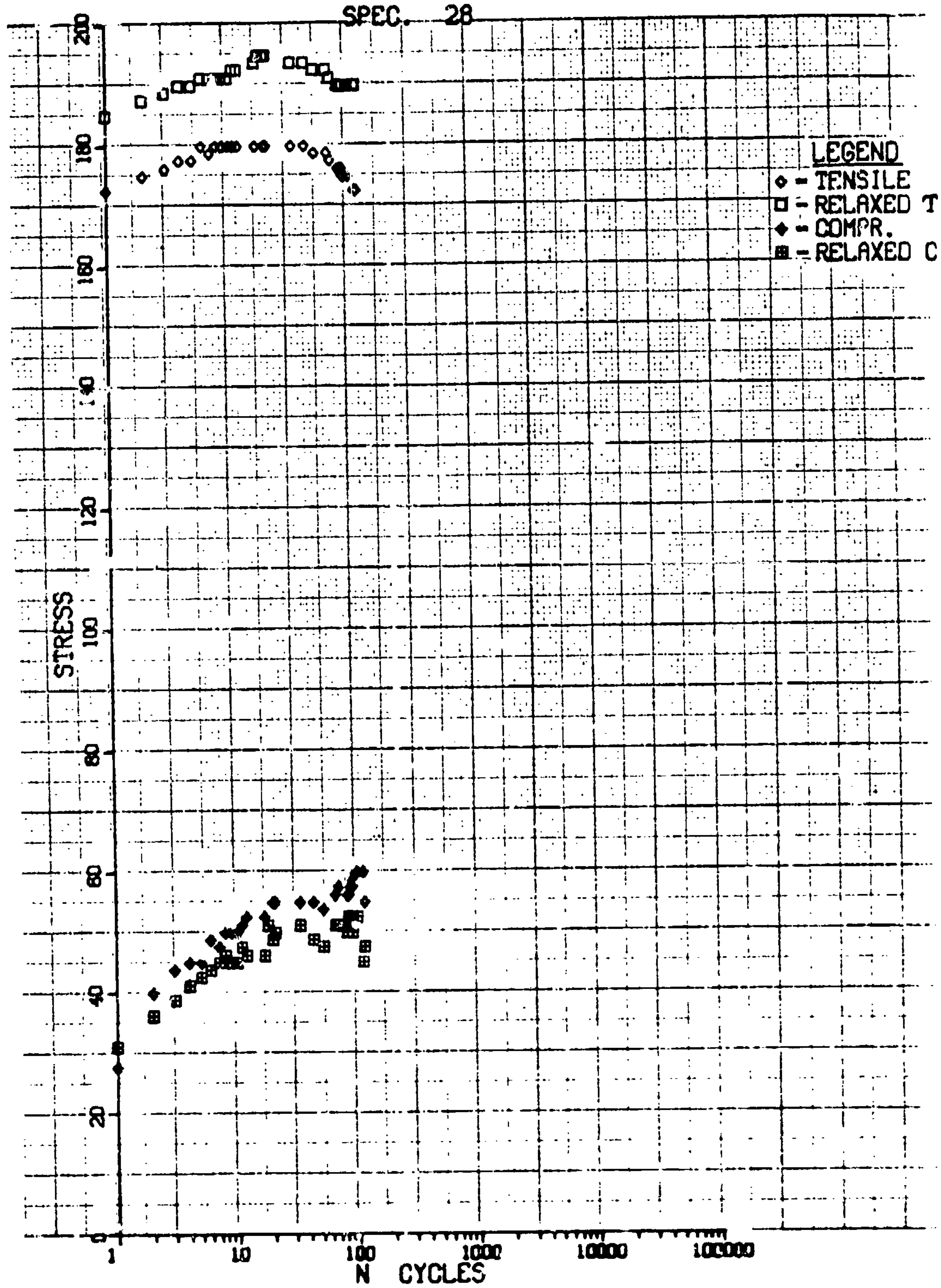
SPECIMEN 28

I	N	%N	STRESSES TENSILE	STRESSES RELAXED	STRESSES COMPR.	STRESSES RELAXED
1	1.	1.	173.	27.5	185.	31.0
2	2.	2.	175.	40.0	188.	36.3
3	3.	3.	176.	43.6	189.	38.8
4	4.	3.	178.	45.0	190.	41.3
5	5.	4.	178.	45.0	190.	42.5
6	6.	5.	180.	48.8	191.	43.8
7	7.	6.	179.	47.5	191.	45.0
8	8.	7.	180.	50.0	191.	46.3
9	9.	8.	180.	50.0	191.	45.0
10	10.	9.	180.	50.0	191.	45.0
11	11.	10.	180.	51.3	193.	47.5
12	12.	10.	180.	52.5	193.	45.3
13	17.	15.	190.	52.5	194.	46.3
14	18.	16.			195.	51.3
15	20.	17.	180.	55.0	195.	48.8
16	21.	18.	180.	55.0	195.	50.0
17	34.	30.	180.	55.0	194.	51.3
18	44.	38.	1[illegible]0.	55.0	194.	48.8
19	52.	45.	179.	53.8	193.	47.5
20	66.	57.	179.	56.3	193.	51.3
21	70.	61.	178.	57.5	191.	51.3
22	83.	72.	176.	56.3	190.	50.0
23	86.	75.	176.	56.3	190.	52.5
24	87.	76.	176.	57.5	190.	51.3
25	90.	78.	176.	58.8	190.	52.5
26	92.	80.	175.	57.5	190.	50.0
27	100.	87.	175.	60.0	190.	52.5
28	113.	98.	173.	60.0	190.	45.0
29	114.	99.	173.	55.0	190.	47.5
30	115.	100.	173.	55.0	190.	47.5



SPEC. 28
LEGEND
◇ - TENSILE
□ - RELAXED T
◆ - COMPR.
■ - RELAXED C
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 92.



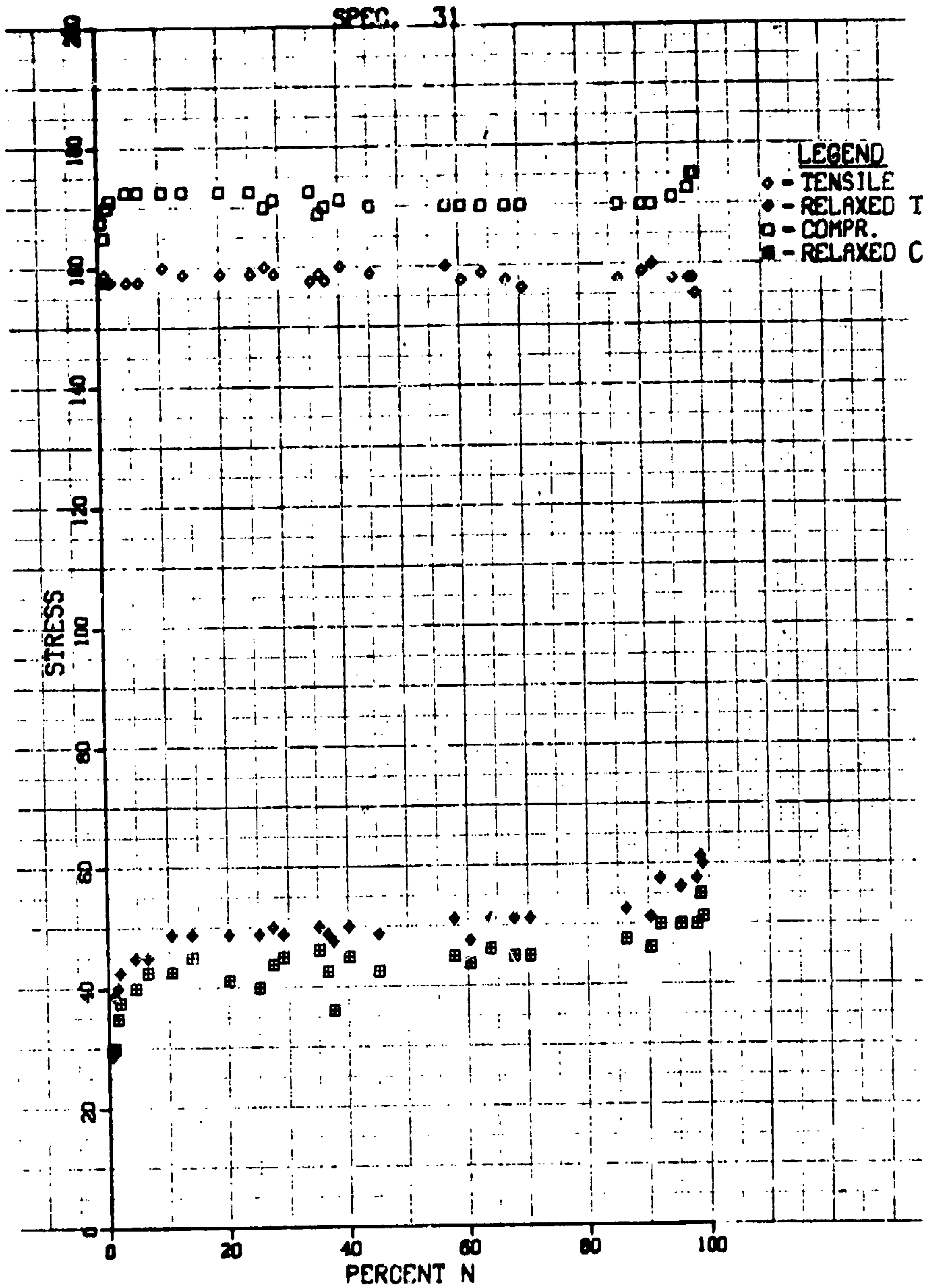
SPEC. 28
LEGEND
◇ - TENSILE
□ - RELAXED T
◆ - COMPR.
⊞ - RELAXED C
STRESS
200
180
160
140
120
100
80
60
40
20
1
10
100
1000
10000
100000
N CYCLES

Figure 93.

TABLE 55

SPECIMEN 31

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			STRESSES			
1	1.	1.	158.	28.8	168.	30.0
2	2.	1.	159.	38.8	165.	30.0
3	3.	2.	158.	40.0	170.	35.0
4	4.	2.	158.	42.5	171.	37.5
5	9.	5.	158.	45.0	173.	40.0
6	13.	7.	158.	45.0	173.	42.5
7	21.	11.	160.	48.8	173.	42.5
8	28.	14.	159.	48.8	173.	45.0
9	40.	20.	159.	48.8	173.	41.3
10	50.	25.	159.	48.8	173.	40.0
11	55.	28.	160.	50.0	170.	43.8
12	58.	29.	159.	48.8	171.	45.0
13	70.	35.	158.	50.0	173.	46.3
14	73.	37.	159.	48.8	169.	42.5
15	75.	38.	158.	47.5	170.	36.3
16	80.	40.	160.	50.0	171.	45.0
17	90.	45.	159.	48.8	170.	42.5
18	115.	58.	160.	51.3	170.	45.0
19	120.	60.	158.	47.5	170.	43.8
20	127.	64.	159.	51.3	170.	46.3
21	135.	68.	158.	51.3	170.	45.0
22	140.	70.	156.	51.3	170.	45.0
23	172.	86.	158.	52.5	170.	47.5
24	180.	90.	159.	51.3	170.	46.3
25	183.	92.	160.	57.5	170.	50.0
26	190.	95.	158.	56.3	171.	50.0
27	195.	98.	158.	57.5	173.	50.0
28	196.	98.	158.	61.3	175.	55.0
29	197.	99.	155.	60.0	175.	51.3



SPEC. 31
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
▣ - RELAXED C
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 94.

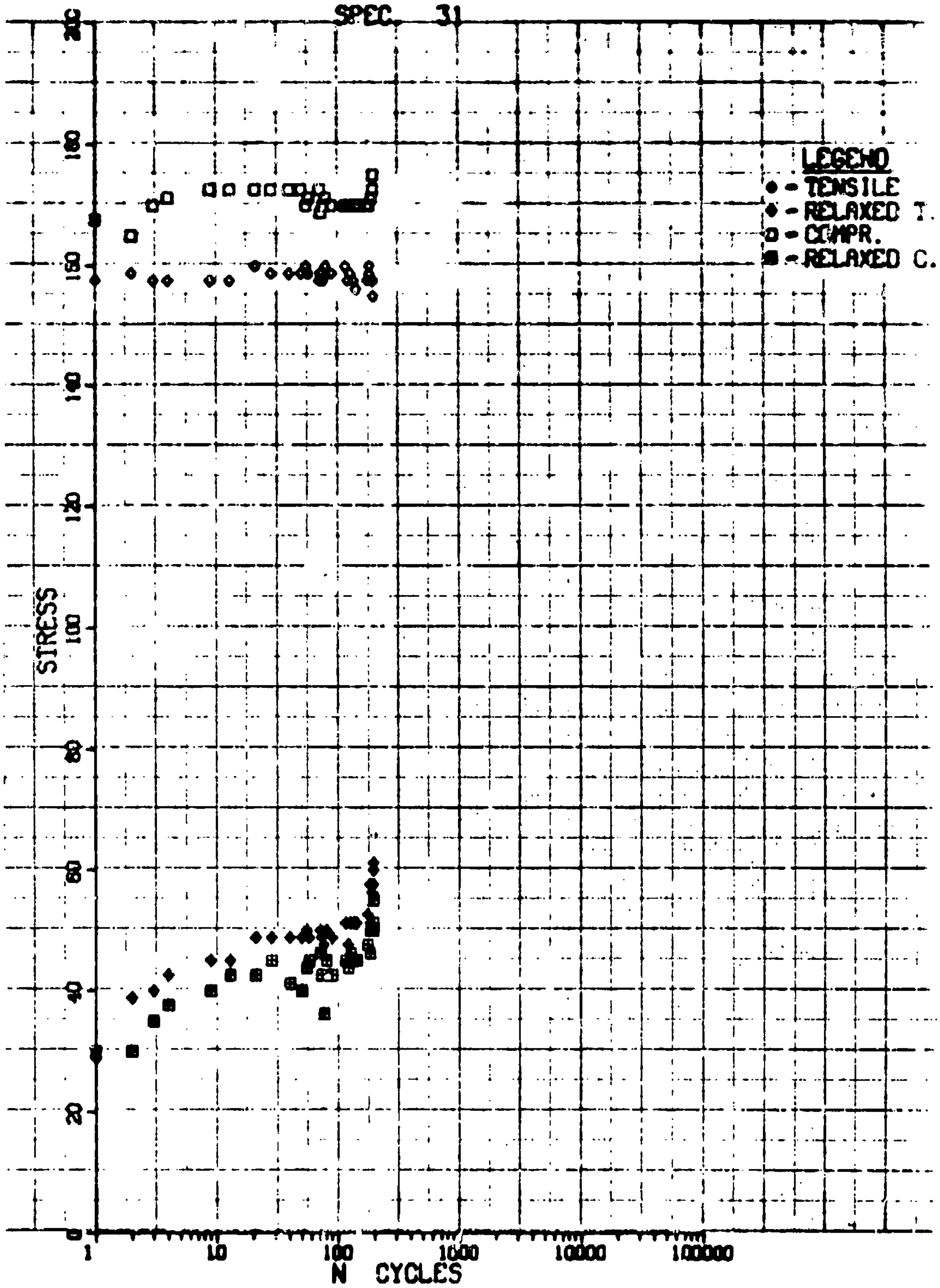

SPEC. 31
LEGEND
• - TENSILE
♦ - RELAXED T.
□ - COMPR.
■ - RELAXED C.
STRESS
N CYCLES
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000

Figure 95.

TABLE 56

SPECIMEN 227

			STRESSES			
I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	160.	12.0	164.	4.0
2	2.	0.	160.	16.0	166.	5.0
3	3.	1.	159.	18.0	167.	6.0
4	4.	1.	160.	23.0	169.	9.0
5	5.	1.	160.	23.0	169.	9.0
6	9.	2.	158.	22.0	169.	8.0
7	15.	3.	154.	22.0	172.	10.0
8	20.	4.	153.	23.0	174.	13.0
9	26.	6.	152.	22.0	174.	11.0
10	31.	7.	152.	22.0	175.	11.0
11	42.	9.	151.	23.0	175.	13.0
12	53.	12.	150.	22.0	174.	10.0
13	59.	13.	150.	22.0	174.	13.0
14	80.	18.	149.	21.0	174.	11.0
15	91.	20.	152.	24.0	174.	14.0
16	97.	21.	148.	21.0	174.	11.0
17	103.	23.	150.	24.0	174.	13.0
18	108.	24.	149.	24.0	174.	12.0
19	120.	26.	149.	24.0	175.	15.0
20	125.	27.	147.	23.0	176.	14.0
21	141.	31.	146.	23.0	176.	13.0
22	152.	33.	146.	24.0	176.	12.0
23	163.	36.	145.	24.0	176.	12.0
24	173.	38.	144.	24.0	178.	16.0
25	222.	49.	144.	24.0	176.	14.0
26	244.	54.	143.	23.0	176.	14.0
27	256.	56.	142.	23.0	176.	14.0
28	266.	58.	141.	23.0	177.	14.0
29	320.	70.	140.	24.0	176.	15.0
30	359.	79.	139.	24.0	175.	15.0
31	364.	80.	140.	26.0	176.	16.0
32	391.	86.	139.	27.0	176.	15.0
33	402.	88.	136.	24.0	176.	16.0
34	408.	90.	136.	25.0	176.	16.0
35	418.	92.	135.	24.0	174.	14.0
36	423.	93.	133.	23.0	174.	16.0
37	423.	94.	132.	24.0	174.	15.0
38	434.	95.	130.	26.0	174.	14.0
39	435.	96.	128.		174.	14.0
40	440.	97.	124.		174.	16.0
41	445.	98.	118.	22.0	173.	14.0
42	446.	98.	117.	23.0	172.	14.0
43	451.	99.	96.	16.0	172.	15.0
44	452.	99.	92.			

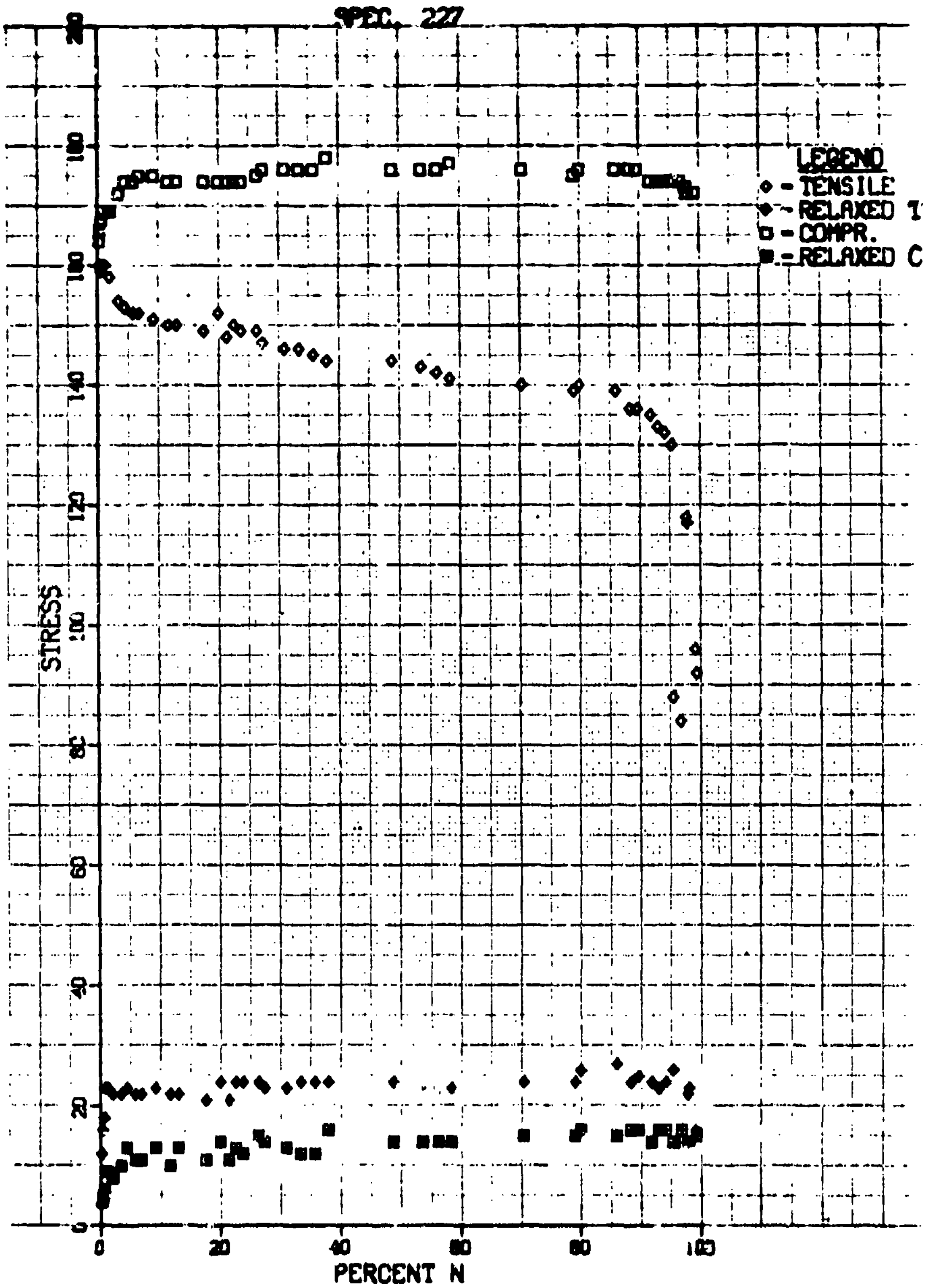
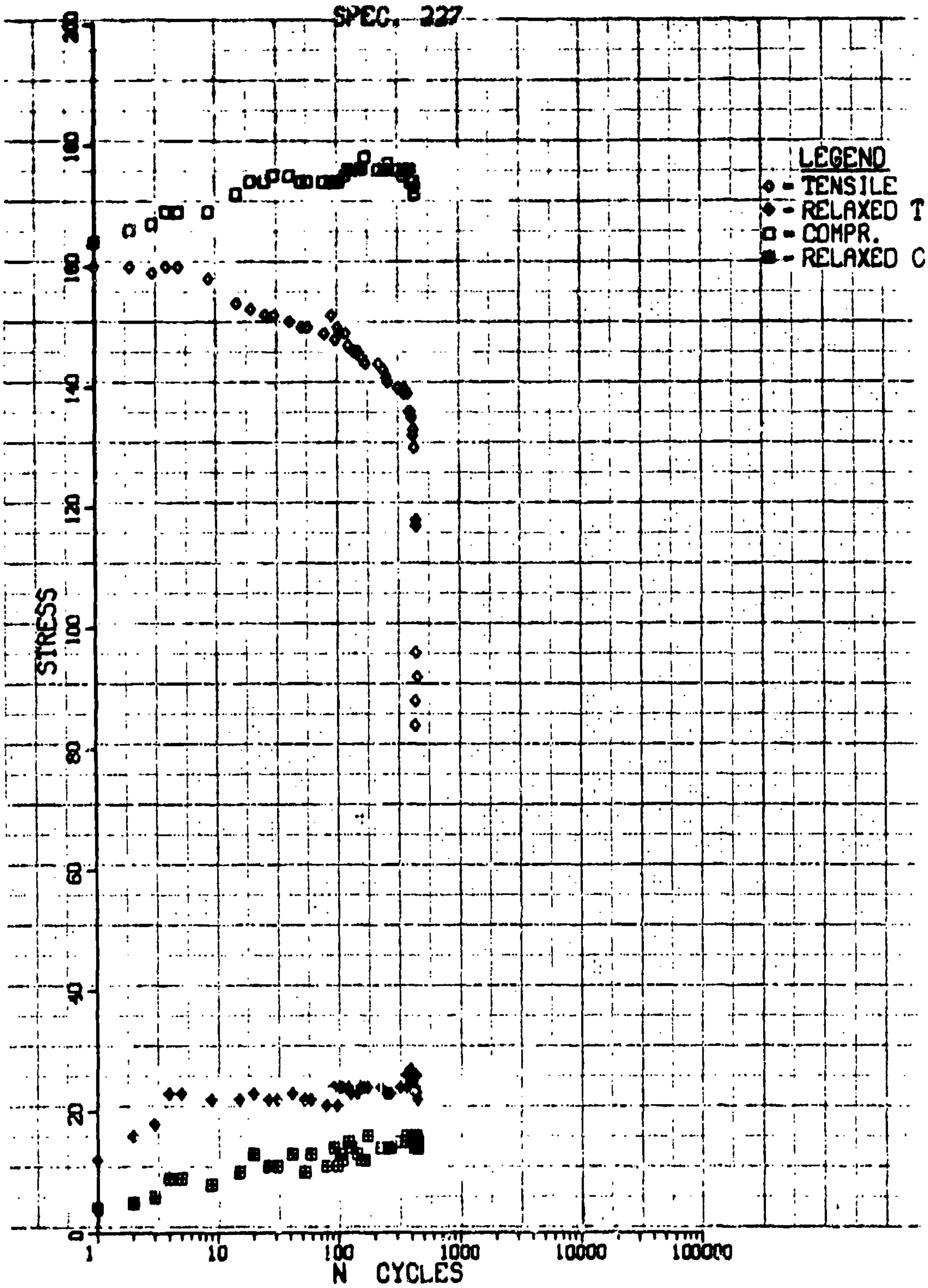

SPEC. 227
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
■ - RELAXED C
STRESS
PERCENT N
0
20
40
60
80
100
120
140
160
180
200

Figure 96.



SPEC. 227
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
■ - RELAXED C
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 97.

TABLE 57

SPECIMEN 223

I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
			---------STRESSES-------			
1	1.	0.	150.	7.0	144.	-2.0
2	2.	0.	146.	6.0	145.	0.0
3	3.	0.	145.	5.0	145.	0.0
4	4.	0.	144.	6.0	146.	0.0
5	5.	1.	144.	8.0	148.	0.0
6	9.	1	140.	6.0	149.	0.0
7	10.	1.	140.	7.0	150.	0.0
8	11.	1.	140.	10.0	152.	0.0
9	12.	1.	138.	6.0	152.	0.0
10	20.	2.	136.	8.0	153.	0.0
11	21.	2.	134.	6.0	153.	0.0
12	31.	3.	133.	6.0	154.	1.0
13	33.	3.	132.	6.0	154.	0.0
14	45.	5.	131.	6.0	155.	1.0
15	54.	6.	130.	7.0	157.	1.0
16	74.	8.	128.	8.0	158.	2.0
17	85.	9.	127.	8.0	159.	2.0
18	107.	11.	126.	8.0	160.	3.0
19	111.	12.	125.	6.0	160.	3.0
20	184.	19.	124.	9.0	160.	3.0
21	195.	21.	123.	8.0	161.	4.0
22	206.	22.	122.	8.0	162.	5.0
23	221.	23.	124.	8.0	160.	
24	252.	27.	123.	10.0	162.	5.0
25	282.	30.	124.	12.0	161.	5.0
26	314.	33.	121.	11.0	163.	5.0
27	316.	33.	120.	8.0	161.	4.0
28	371.	39.	118.	8.0	163.	5.0
29	439.	46.	120.	12.0	164.	6.0
30	467.	49.	120.	12.0	163.	5.0
31	522.	55.	117.	11.0	164.	7.0
32	591.	63.	116.	11.0	164.	4.0
33	620.	66.	116.	12.0	164.	6.0
34	585.	72.	116.	13.0	164.	6.0
35	687.	73.	116.	14.0	165.	6.0
36	740.	78.	115.	13.0	165.	7.0
37	742.	79.	114.	12.0	165.	7.0
38	751.	79.	114.	12.0	164.	6.0
39	763.	81.	116.	15.0	164.	8.0
40	787.	83.	114.	14.0	165.	8.0
41	849.	90.	116.	16.0	163.	7.0
42	893.	94.	114.	14.0	161.	8.0
43	914.	97.	112.	15.0	162.	5.0
44	916.	97.	112.	14.0	163.	8.0
45	925.	98.	111.	16.0	163.	9.0
46	926.	98.	110.	15.0	162.	7.0
47	927.	98.	109.	15.0	162.	7.0
48	935.	99.	104.	14.0	161.	8.0
49	939.	99.	102.	14.0	161.	8.0
50	940.	99.	100.	14.0	160.	7.0

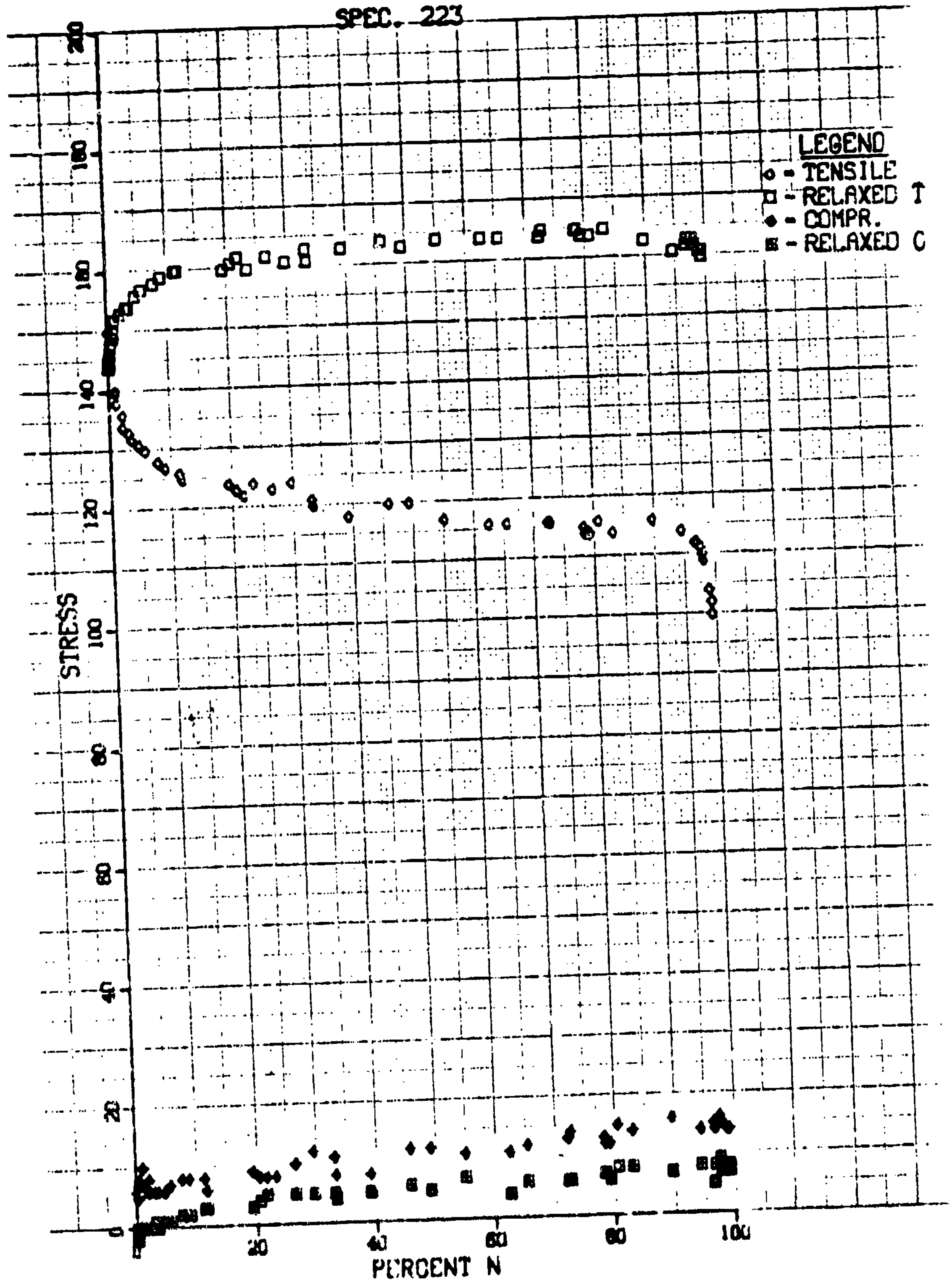
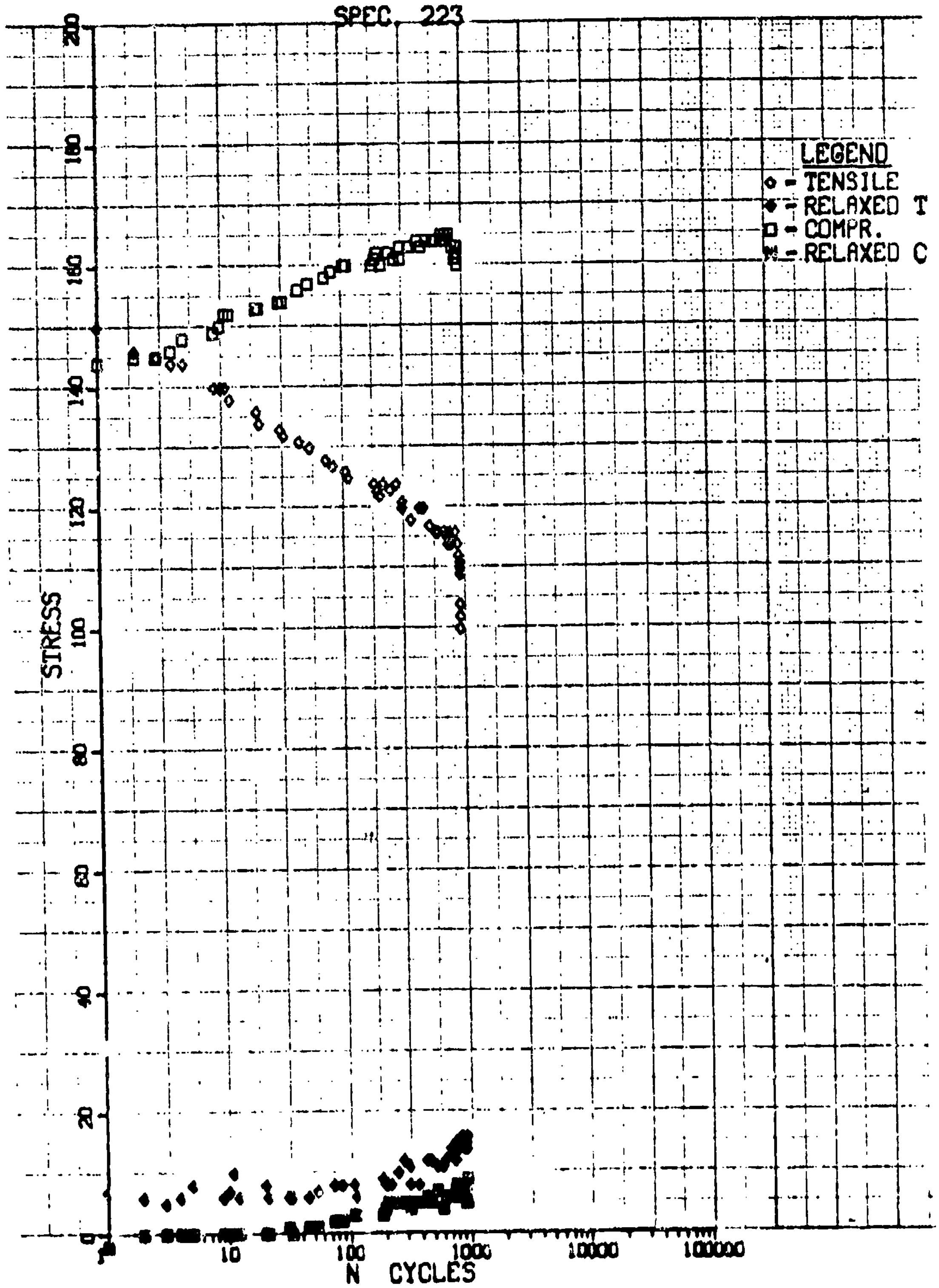

SPEC. 223
LEGEND
◇ - TENSILE
□ - RELAXED T
◆ - COMPR.
■ - RELAXED C
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N

Figure 98.



SPEC. 223
LEGEND
◇ - TENSILE
◆ - RELAXED T
□ - COMPR.
⊠ - RELAXED C
STRESS
N CYCLES
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000

Figure 99.

TABLE 58

SPECIMEN 226

I	N	%N	STRESSES TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.	166.	5.0	165.	5.0
2	2.	1.	164.	7.0	168.	10.0
3	3.	1.	165.	9.0	168.	12.0
4	4.	1.	165.	9.0	168.	10.0
5	5.	1.	164.	8.0	168.	
6	8.	2.	165.	11.0	167.	11.0
7	14.	4.	166.	10.0	166.	10.0
8	19.	5.	165.	11.0	166.	13.0
9	25.	7.	165.	12.0	166.	13.0
10	31.	9.	166.	12.0	165.	12.0
11	36.	10.	167.	13.0	165.	12.0
12	41.	12.	166.	13.0	165.	13.0
13	46.	13.	165.	12.0	164.	12.0
14	64.	18.	166.	14.0	164.	
15	68.	19.	166.	14.0	164.	13.0
16	69.	20.	165.	13.0	164.	14.0
17	85.	24.	165.	14.0	162.	13.0
18	95.	27.	168.	16.0	161.	12.0
19	118.	34.	167.	15.0	160.	12.0
20	123.	35.	167.	15.0	161.	15.0
21	128.	37.	169.	16.0	160.	15.0
22	133.	38.	168.	16.0	160.	16.0
23	161.	46.	166.	16.0	160.	13.0
24	166.	48.	165.	17.0	161.	13.0
25	176.	51.	164.	15.0	160.	13.0
26	210.	60.	168.	17.0	158.	15.0
27	220.	63.	168.	16.0	156.	15.0
28	248.	71.	168.	18.0	156.	14.0
29	253.	72.	168.	17.0	155.	15.0
30	259.	74.	168.	20.0	156.	16.0
31	270.	77.	165.	15.0	156.	14.0
32	280.	80.	164.	16.0	157.	16.0
33	291.	83.	163.	15.0	157.	15.0
34	302.	87.	162.	16.0	157.	15.0
35	313.	90.	162.	17.0	157.	16.0
36	324.	93.	162.	15.0	154.	16.0
37	335.	96.	164.	17.0	154.	17.0
38	341.	98.	164.	18.0	154.	18.0
39	345.	99.				
40	346.	99.	159.	19.0	156.	16.0
41	347.	99.	150.	17.0	156.	

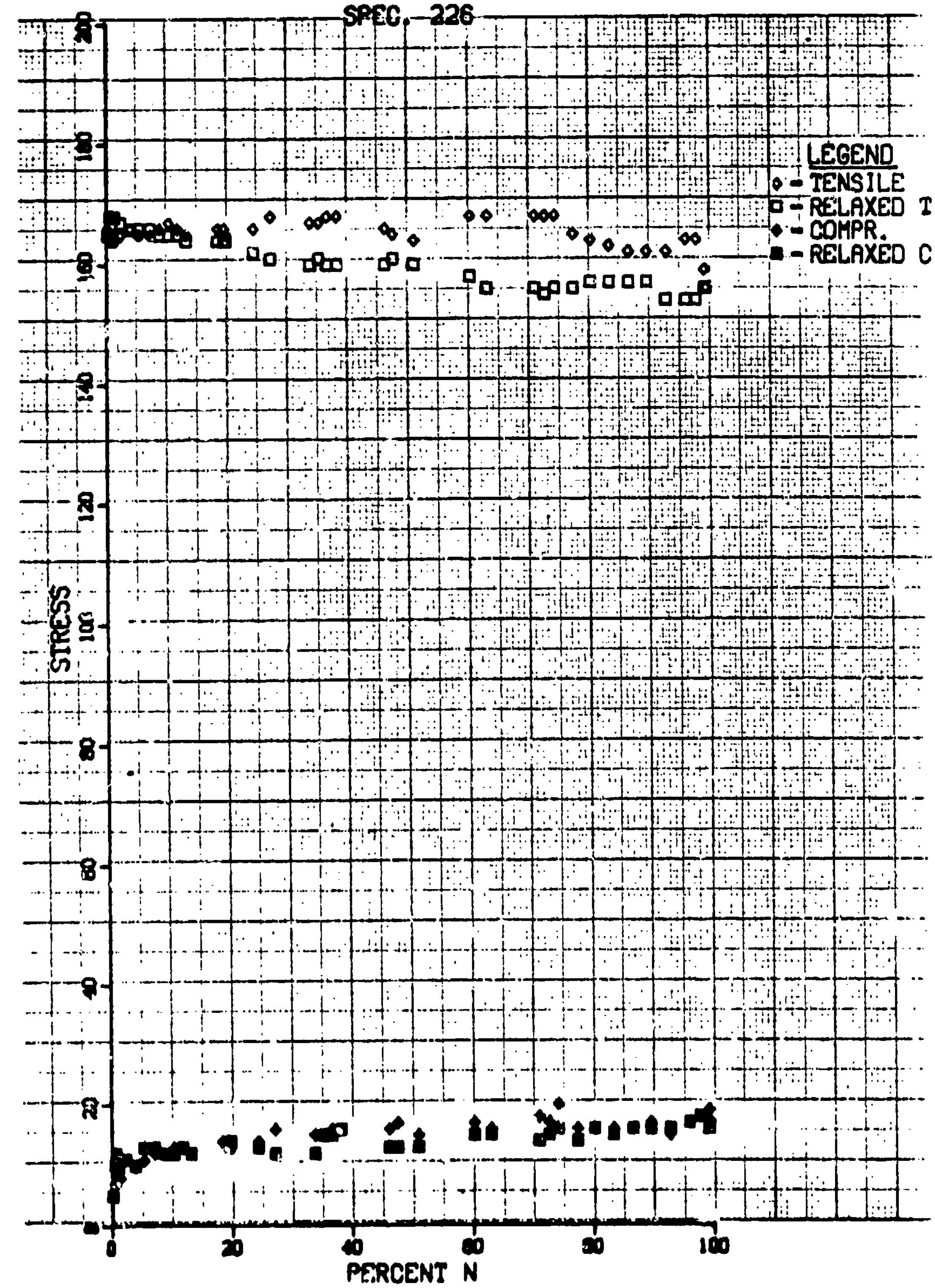

SPEC. 226
LEGEND
◇ - TENSILE
□ - RELAXED T
◆ - COMPR.
■ - RELAXED C
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N

Figure 100.

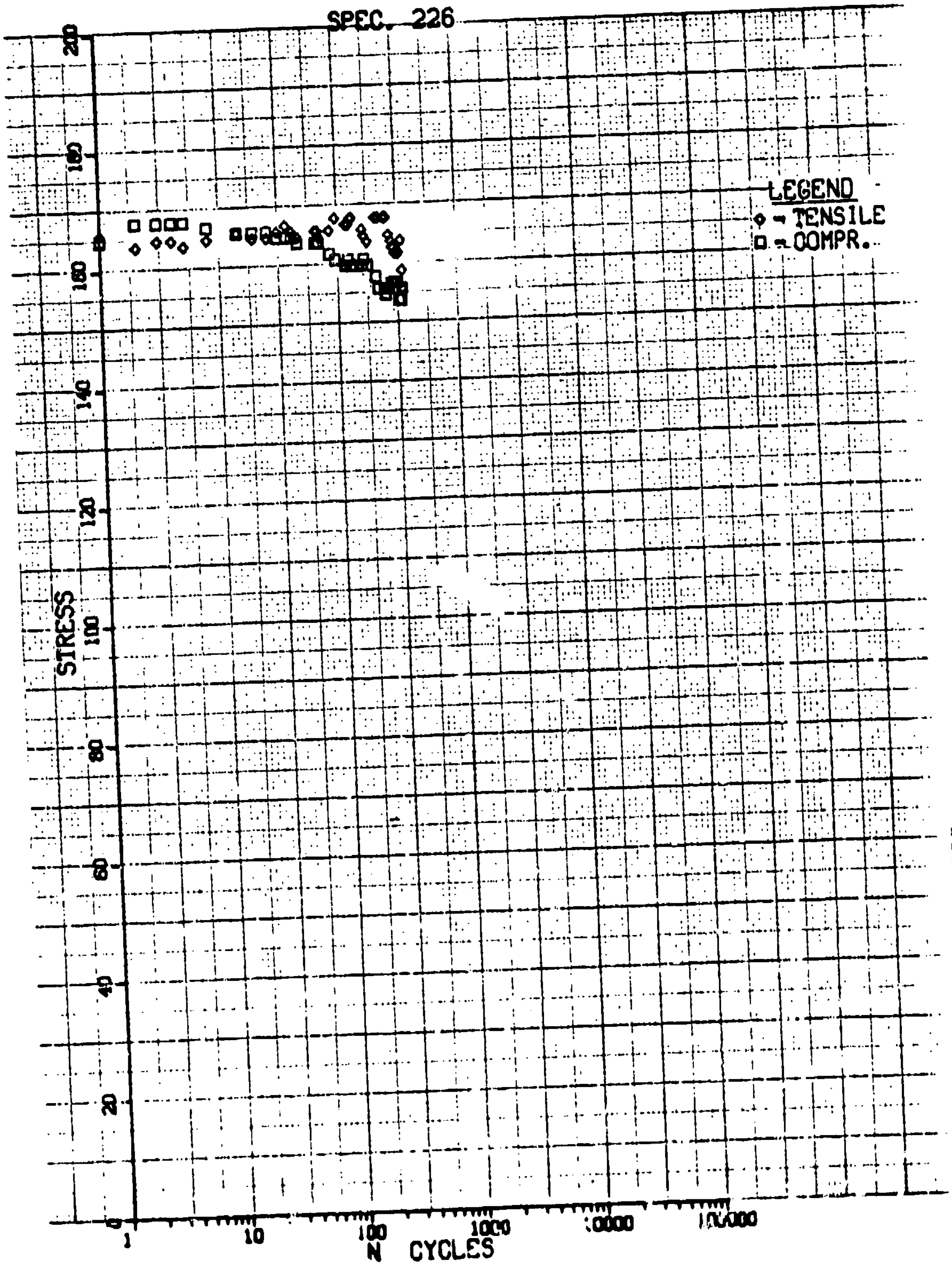
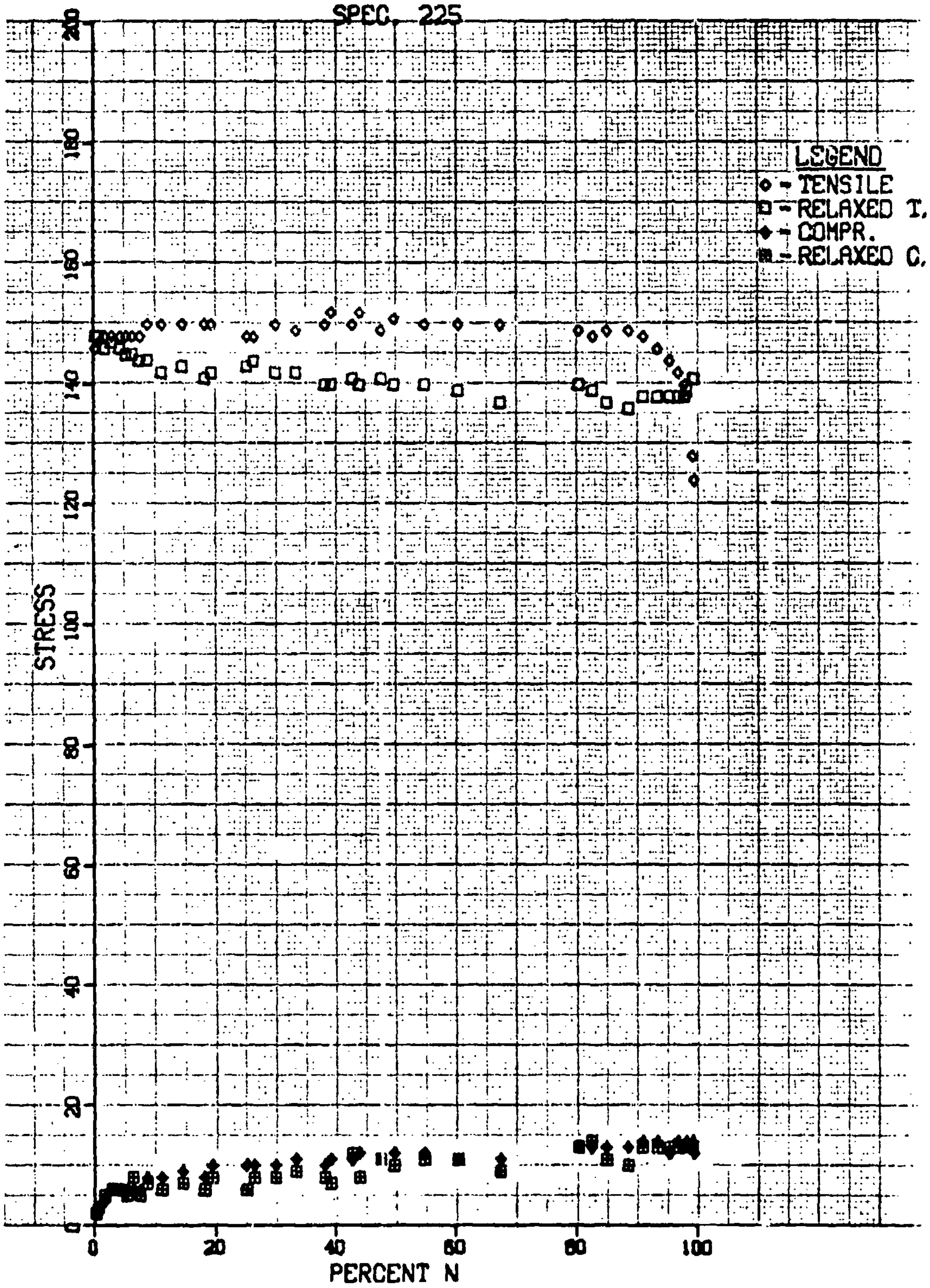

SPEC. 226
LEGEND
◇ - TENSILE
□ - COMPR.
STRESS
200
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
100000
N CYCLES

Figure 101.

TABLE 59

SPECIMEN 225

			---------STRESSES-------			
I	N	%N	TENSILE	RELAXED	COMPR.	RELAXED
1	1.	0.				
2	2.	0.	146.	2.0	148.	2.0
3	4.	1.	147.	3.0	146.	3.0
4	8.	2.	148.	4.0	140.	5.0
5	14.	3.	148.	5.0	147.	6.0
6	20.	4.	148.	5.0	146.	6.0
7	25.	5.	148.	6.0	145.	5.0
8	30.	6.	148.	6.0	145.	8.0
9	35.	8.	148.	6.0	144.	5.0
10	41.	9.	150.	8.0	144.	7.0
11	52.	11.	150.	8.0	142.	6.0
12	68.	15.	150.	9.0	143.	7.0
13	84.	18.	150.	8.0	141.	6.0
14	90.	19.	150.	10.0	142.	8.0
15	117.	25.	148.	10.0	143.	6.0
16	122.	26.	148.	10.0	144.	8.0
17	139.	30.	150.	10.0	142.	8.0
18	155.	33.	149.	11.0	142.	9.0
19	177.	38.	150.	10.0	140.	8.0
20	182.	39.	152.	11.0	140.	7.0
21	199.	43.	150.	11.0	141.	12.0
22	204.	44.	152.	12.0	140.	8.0
23	221.	48.	149.	11.0	141.	11.0
24	231.	50.	151.	12.0	140.	10.0
25	254.	55.	150.	12.0	140.	11.0
26	280.	60.	150.	11.0	139.	11.0
27	313.	67.	150.	11.0	137.	9.0
28	373.	80.	149.	13.0	140.	13.0
29	383.	83.	148.	13.0	139.	14.0
30	394.	85.	149.	13.0	137.	11.0
31	411.	89.	149.	13.0	138.	10.0
32	422.	91.	148.	14.0	138.	13.0
33	433.	93.	146.	14.0	138.	13.0
34	443.	95.	144.	12.0	138.	13.0
35	449.	97.	142.	14.0	138.	13.0
36	454.	98.	140.	13.0	138.	13.0
37	456.	98.	130.	14.0	139.	
38	460.	99.	128.	14.0	141.	13.0
39	461.	99.	124.	12.0	141.	



SPEC. 225
LEGEND
◇ - TENSILE
□ - RELAXED T.
◆ - COMPR.
▣ - RELAXED C.
STRESS
0
20
40
60
80
100
120
140
160
180
200
PERCENT N

Figure 102.

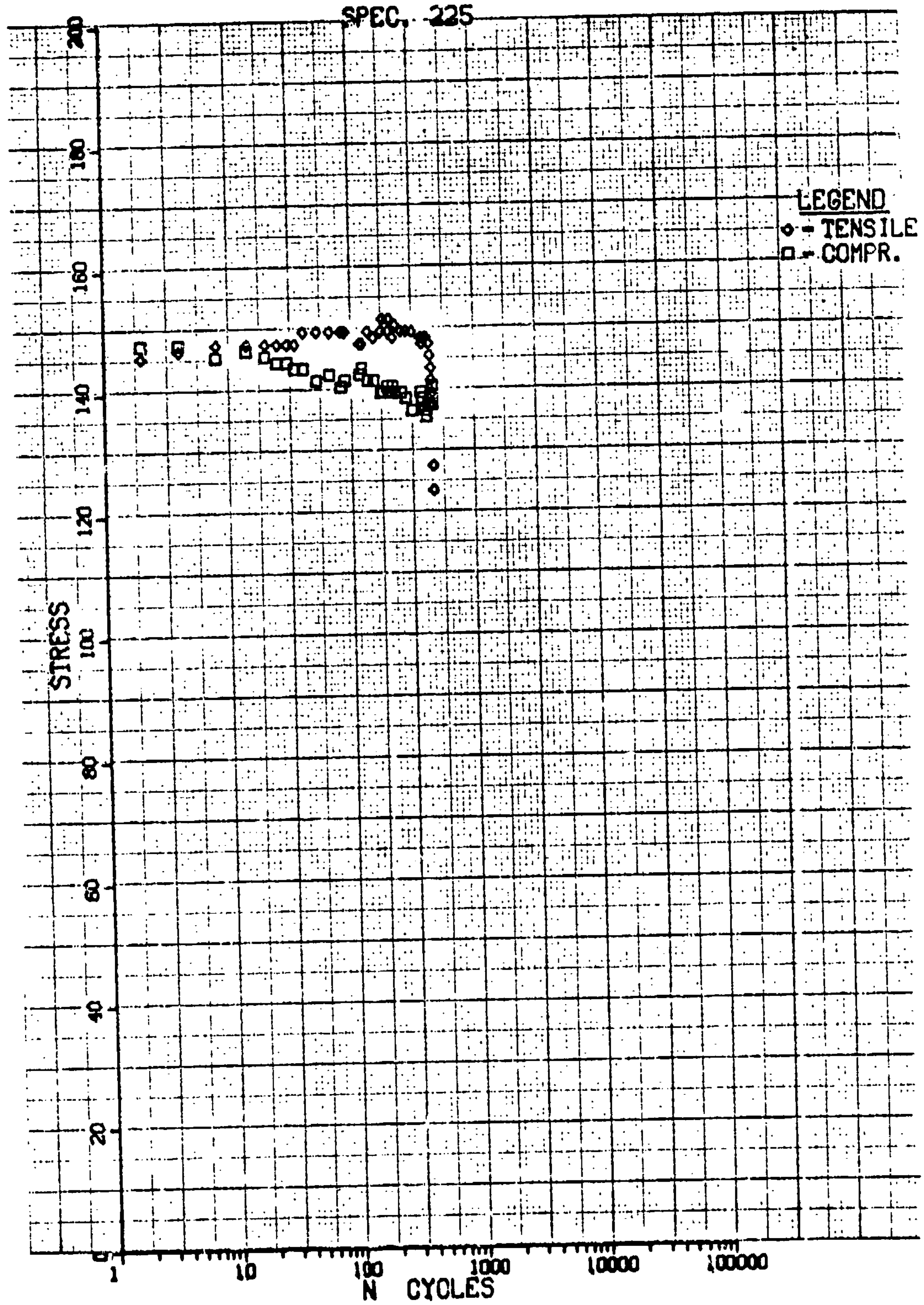

SPEC. 225
LEGEND
◇ - TENSILE
□ - COMPR.
STRESS
0
20
40
60
80
100
120
140
160
180
200
1
10
100
1000
10000
100000
N CYCLES

Figure 103.

SECTION 12
AF-115 DATA

This section contains data for AF-115. The data are given in Tables 60 through 65.

TABLE 60

SAMPLE		CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-1		40	139.92	-81.84
		60	138.92	-83.83
		100	137.52	-84.13
		180	137.13	-85.43
		260	137.01	-85.40
		340	137.72	-85.03
		420	136.81	-85.83
		500	138.52	-84.59
		580	137.76	-84.23
		660	137.60	-84.20
		740	136.53	-85.03
		820	132.93	-87.62
		860	123.75	-90.62
	(Failure)	883	-	-

TABLE 61

SAMPLE		CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-2		30	136.00	-36.40
		64	134.80	-39.20
		104	134.00	-39.96
		184	133.40	-40.00
		264	133.00	-40.04
		344	132.80	-40.40
		424	132.84	-40.20
		504	132.68	-40.50
		584	132.72	-40.32
		664	133.40	-40.38
		744	132.60	-40.80
		824	132.64	-40.52
		904	132.40	-40.40
		984	133.20	-40.08
		1064	133.80	-40.00
		1144	134.80	-39.60
		1224	135.48	-38.80
		1304	135.80	-38.92
		1384	136.00	-38.32
		1464	135.60	-39.40
		1544	135.52	-39.80
		1624	135.60	-39.83
		1704	134.60	-40.01
		1784	134.00	-40.36
		1864	133.20	-40.12
		1944	132.40	-40.39
		2024	132.00	-41.60
		2104	130.80	-42.32
		2144	129.20	-43.60
	(Failure)	2153	-	-

TABLE 62

SAMPLE		CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
5-2		40	152.59	-83.63
		108	151.39	-84.26
		168	151.20	-85.06
		248	151.08	-85.26
		328	151.39	-85.66
		408	151.31	-85.98
		488	151.08	-86.06
		568	150.60	-86.65
		648	149.80	-87.25
		728	150.08	-87.05
		808	150.20	-87.25
		888	149.48	-86.85
		968	149.08	-87.25
		1048	147.81	-87.65
		1088	146.81	-88.25
		1128	143.35	-90.12
	(Failure)	1172	-	-

TABLE 63

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
5-5	40	137.85	-13.15
	93	136.06	-14.34
	253	135.86	-15.14
	413	135.58	-15.54
	573	135.52	-15.16
	733	135.84	-15.14
	893	136.41	-13.94
	1453	136.25	-14.74
	1213	136.30	-14.14
	1373	135.86	-14.74
	1533	136.45	-14.34
	1693	136.06	-14.50
	1853	137.45	-13.55
	2013	137.33	-13.75
	2173	137.05	-13.94
	2333	137.65	-13.75
	2493	137.85	-13.55
	2653	136.65	-14.34
	2813	137.05	-13.55
	2973	136.45	-13.94
	3133	138.25	-12.95
	3293	138.45	-12.35
	3453	138.65	-13.15
	3613	138.84	-12.35
	3773	139.12	-12.15
	3933	139.04	-12.13
	4093	139.20	-11.95
	4253	139.32	-11.99
	4413	139.04	-12.35
	4573	138.92	-12.41
	4733	139.00	-13.15
	4893	139.20	-12.17
	5053	138.25	-12.75
	5213	138.65	-12.55
	5373	139.32	-12.03
	5533	138.45	-12.35
	5693	139.32	-11.91
	5853	138.92	-12.03
	6013	138.84	-12.55
	6173	138.73	-12.35
	6333	139.12	-11.99
	6493	139.16	-11.95
	6653	139.22	-11.97
	6813	139.28	-11.75

TABLE 63 Continued

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
5-5 Cont'd	6973	138.25	-12.35
	7133	139.12	-12.15
	7293	139.16	-11.95
	7453	138.84	-12.13
	7613	139.32	-11.99
	7773	139.14	-11.96
	7933	138.65	-12.55
	8093	138.92	-12.25
	8253	138.87	-11.97
	8413	139.32	-11.95
	8573	138.65	-12.05
	8733	138.84	-12.02
	8893	138.25	-12.65
	9053	138.65	-12.07
	9213	138.05	-12.35
	9373	138.65	-12.03
	9533	138.92	-11.97
	9693	138.65	-11.95
	9853	138.60	-12.35
	10013	137.45	-12.27
	10173	138.25	-12.15
	10333	138.27	-12.27
	10493	137.85	-12.35
	10653	138.45	-12.07
	10813	138.25	-12.27
	10973	138.27	-12.35
	11133	139.04	-11.91
	11293	138.84	-12.07
	11453	139.04	-12.15
	11613	139.06	-11.95
	11773	137.53	-12.55
	11933	138.25	-12.27
	12093	138.69	-12.08
	12253	139.18	-11.75
	12413	139.07	-11.96
	12573	139.04	-11.95
	12733	139.05	-11.97
	12893	139.12	-11.92
	13053	139.23	-11.94
	13213	138.65	-12.27
	13373	138.96	-12.75
	13533	139.02	-11.99
	13693	139.32	-11.97
	13853	139.12	-11.95
	14013	139.40	-11.94

TABLE 62 Continued

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
5-5 Cont'd	14173	139.32	-11.95
	14333	139.35	-11.93
	14493	139.38	-11.92
	14653	138.65	-12.35
	14813	139.04	-11.90
	14973	139.40	-11.98
	15133	139.12	-12.06
	15293	139.44	-11.55
	15453	139.47	-11.97
	15613	139.32	-12.02
	15773	139.40	-12.00
	15933	139.44	-11.95
	16093	139.42	-11.97
	16253	139.39	-12.01
	16413	139.47	-11.93
	16573	139.36	-11.94
	16733	139.12	-11.97
	16893	139.45	-11.90
	17053	139.47	-11.92
	17133	139.50	-12.02
	17213	139.49	-11.95
	17293	140.24	-11.55
	17333	141.43	-11.35
	17413	143.43	-9.56
(Failure)	17433	-	-

TABLE 64

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
5-7	35	141.95	-80.52
	98	139.56	-83.54
	138	139.64	-83.50
	178	139.58	-83.52
	218	139.62	-83.50
	258	139.63	-83.50
	298	139.72	-83.18
	338	139.92	-82.78
	378	140.99	-81.91
	418	141.07	-82.50
	458	141.55	-82.70
	498	141.25	-82.55
	538	141.15	-82.31
	578	141.55	-81.51
	618	139.96	-82.70
	658	140.24	-83.10
	698	140.29	-83.10
	738	143.02	-81.51
(Failure)	763	-	-

TABLE 65

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
5-8	32	142.25	-55.38
	70	140.71	-57.71
	110	140.51	-58.02
	150	140.68	-58.10
	190	141.90	-57.31
	230	141.98	-57.23
	270	141.93	-56.92
	310	142.29	-56.84
	350	141.78	-56.56
	390	142.29	-56.32
	430	142.33	-56.90
	470	142.69	-56.13
	510	142.30	-56.05
	550	142.33	-56.32
	590	142.70	-55.93
	630	142.71	-56.45

No more data measured.

SECTION 13

AF2-1DA DATA

Fatigue data for AF2-1DA are presented in Tables 66 through 85.

TABLE 66

20 cpm SAMPLE	1400°F CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-2	33	142.84	-140.55
	71	142.25	-140.11
	109	142.4	-144.9
	170	141.47	-144.9
	194	141.38	-144.18
	228	141.67	-144.19
	262	141.06	-144.23
(Failure)	285	127.88	2.760

TABLE 67

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
B1-22	40	134.79	-122.07
	80	133.60	-123.86
	120	132.41	-124.06
	160	131.61	-124.45
	200	130.64	-124.06
	240	131.61	-123.98
	280	131.62	-123.66
	320	131.21	-123.26
	360	131.21	-123.26
	400	131.23	-123.25
	440	131.59	-122.86
	480	131.19	-122.66
	520	130.42	-122.39
	560	129.22	-122.66
	600	127.63	-123.26
	640	124.25	-123.28
	680	109.34	-123.26
(Failure)	688	91.45	3.98

TABLE 68

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-8	40	129.22	-114.12
	90	128.43	-115.31
	140	127.44	-113.55
	180	127.24	-114.53
	220	127.32	-115.71
	260	127.04	-116.50
	300	126.84	-114.52
	340	126.80	-115.90
	380	126.44	-116.10
	420	126.84	-116.10
	460	125.65	-116.03
	500	125.84	-116.10
	540	125.25	-116.30
	580	124.25	-115.90
	620	123.26	-115.83
	660	117.30	-115.88
	700	111.33	-116.70
(Failure)	732	-	-

TABLE 69

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-19	40	131.21	-95.63
	110	128.83	-96.90
	190	30.02	-97.61
	270	128.43	-98.21
	350	128.03	-98.81
	430	127.63	-99.20
	510	127.83	-99.40
	590	127.44	-99.25
	670	127.51	-99.42
	750	127.24	-99.44
	830	127.71	-98.61
	910	127.08	-99.43
	990	126.72	-99.45
	1070	126.64	-99.40
	1150	125.65	-99.50
	1230	125.84	-99.40
	1310	125.05	-99.52
	1390	124.45	-99.96
	1470	123.22	-100.60
	1550	120.48	-100.99
	1630	108.55	-
(Failure)	1640		

TABLE 70

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-7	40	131.21	-64.02
	106	130.42	-69.98
	186	124.65	-71.17
	266	123.86	-71.65
	346	123.84	-72.17
	426	124.06	-71.61
	506	123.26	-72.56
	586	122.70	-73.76
	666	122.64	-73.96
	746	122.07	-73.96
	826	125.25	-74.35
	906	121.27	-74.55
	986	121.47	-75.15
	1066	120.48	-75.55
	1146	121.07	-75.15
	1226	120.87	-74.95
	1306	120.68	-74.16
	1386	120.60	-74.75
	1466	119.88	-75.55
	1546	119.48	-75.52
	1626	119.68	-75.75
	1706	121.27	-74.79
	1786	119.70	-75.54
	1866	119.28	-75.57
	1946	119.56	-75.15
	2026	119.36	-75.13
	2106	119.32	-75.55
	2186	119.70	-74.75
	2266	119.22	-75.60
	2346	118.89	-75.75
	2426	118.69	-75.59
	2506	115.31	-77.53
	2586	111.33	-79.20
(Failure)	2666	81.51	-85.49

TABLE 71

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-24	40	130.42	-54.8
	147	127.28	-56.46
	227	127.24	-57.65
	301	126.84	-58.25
	387	126.44	-58.85
	467	126.24	-59.24
	547	126.04	-59.17
	627	126.02	-58.85
	707	126.00	-59.05
	787	125.84	-58.89
	867	125.84	-59.40
	947	125.65	-59.05
	1027	125.63	-59.52
	1107	125.45	-58.85
	1187	125.25	-58.65
	1267	125.25	-59.56
	1347	125.13	-59.48
	1427	125.05	-59.05
	1507	125.25	-59.61
	1587	125.21	-59.48
	1667	124.45	-59.64
	1747	124.29	-59.65
	1827	124.25	-59.72
	1907	124.06	-59.56
	1987	124.06	-59.64
	2067	124.05	-59.63
	2147	123.98	-59.65
	2227	124.33	-59.60
	2307	123.90	-59.63
	2387	124.06	-59.61
	2467	124.45	-59.48
	2547	124.33	-59.62
	2627	124.07	-59.72
	2707	123.66	-59.64
	2787	123.76	-59.63
	2867	123.82	-59.65
	2947	123.74	-59.60
	3027	123.46	-59.72
	3107	123.34	-59.80
	3187	124.06	-59.54
	3267	123.46	-59.96
	3347	123.26	-60.44
	3427	117.22	-66.09
(Failure)			

TABLE 72

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-25	40	123.26	-63.62
	80	123.66	-63.82
	130	123.65	-64.24
	210	123.26	-65.21
	290	123.06	-64.89
	370	122.86	-64.81
	450	123.66	-64.02
	530	123.14	-64.93
	610	122.47	-65.01
	690	122.66	-65.21
	770	122.72	-64.51
	850	122.94	-64.81
	930	122.66	-65.01
	1010	121.47	-65.73
	1090	121.67	-66.00
	1170	122.15	-65.69
	1250	12[illegible].47	-65.21
	1330	121.67	-65.41
	1410	121.27	-66.60
	1490	122.07	-67.61
	1570	122.66	-65.41
	1650	123.26	-64.73
	1730	123.25	-64.33
	1810	123.27	-64.81
	1890	123.46	-64.21
	1970	123.52	-64.22
	2050	123.43	-64.77
	2130	123.18	-65.37
	2210	122.74	-65.69
	2290	123.06	-65.21
	2370	123.18	-65.01
	2450	123.26	-64.41
	2530	123.18	-65.33
	2610	122.82	-65.41
	2690	123.24	-65.21
	2770	123.26	-64.41
	2850	123.46	-69.33
	2930	123.44	-64.61
	3010	122.94	-65.37
	3090	123.14	-65.21
	3170	123.13	-65.21
	3250	123.26	-65.10
	3330	122.47	-65.81
	3370	119.28	-70.78
(Failure)	3385		

TABLE 73

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-1	40	126.44	-51.89
	116	125.05	-53.68
	196	124.53	-54.27
	356	123.66	-55.27
	516	124.21	-54.87
	676	123.58	-55.63
	836	123.06	-56.25
	996	122.86	-55.47
	1156	122.66	56.36
	1316	122.07	-53.48
	1476	123.14	-56.46
	1636	121.47	-57.85
	1796	122.47	-57.42
	1956	122.94	-56.26
	2116	121.67	-58.45
	2276	122.27	-57.65
	2436	122.66	-57.65
	2596	122.86	-56.86
	2756	123.26	-55.98
	2916	123.26	-56.47
	3078	123.28	-56.10
	3236	122.94	-57.65
	3396	123.22	-56.46
	3556	123.06	-57.26
	3716	122.66	-57.46
	3876	123.26	-56.06
	4036	122.43	-57.06
	4196	123.06	-56.06
	4356	123.24	-56.18
	4516	123.06	-57.65
	5676	123.26	-56.46
	4836	127.36	-57.26
	4996	123.24	-56.26
	5156	122.47	-56.86
	5316	122.15	-58.17
	5476	123.06	-57.06
	5636	123.26	-56.38
	5796	121.47	-57.85
	5956	122.66	-57.26
	6116	123.06	-57.06
	6276	121.67	-58.25
	6436	123.26	-56.46
	6595	123.27	-56.62
	6756	123.24	-57.26
	6916	123.14	-57.65
	6996	123.86	-57.34
(Failure)	7041	127.44	-54.87

TABLE 74

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-15	54	123.86	-37.38
	92	124.06	-38.77
	212	123.46	-39.66
	332	123.06	-39.76
	572	122.86	-39.77
	812	122.07	-40.36
	1052	121.87	-40.56
	1292	122.58	-39.76
	1532	122.50	-39.96
	1772	122.66	-39.76
	2012	122.47	-39.80
	2252	122.27	-39.88
	2492	122.66	-40.08
	2732	122.47	-39.76
	2972	123.22	-39.75
	3212	121.67	-40.36
	3452	122.47	-39.76
	3692	122.67	-39.72
	3932	123.06	-39.56
	4172	122.90	-39.84
	4412	122.86	-39.74
	4652	122.39	-39.80
	4892	122.66	-39.70
	5132	122.87	-39.72
	5372	123.06	-39.84
	5612	123.22	-39.88
	5852	122.94	-39.76
	6092	123.25	-39.44
	6332	123.26	-39.74
	6572	123.14	-39.68
	6812	123.27	-39.76
	7052	123.04	-39.72
	7292	123.26	-38.97
	7532	123.22	-39.56
	7772	123.26	38.97
	8012	122.86	-39.36
	8252	122.66	-39.56
	8492	123.06	-38.56
	8732	123.07	-39.17
	8972	123.26	-38.97
	9212	122.86	-39.36
	9452	123.26	-38.77
	9692	123.24	-38.77
	9932	124.06	-36.98
	10172	123.46	-37.97
	10292	122.66	-39.76
	10332	118.89	-44.53
(Failure)	10352		

TABLE 75

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-11	40	119.32	-43.74
	100	119.28	-43.94
	140	119.32	-44.14
	220	119.28	-43.94
	460	118.89	-44.53
	620	119.09	-44.14
	940	119.68	-43.76
	1260	119.20	-44.73
	1580	118.81	-45.53
	1900	118.89	-45.33
	2220	119.28	-44.33
	2540	119.09	-44.53
	2860	117.38	-45.81
	3180	117.89	-46.12
	3500	118.53	-45.33
	3820	118.89	-45.05
	4140	117.69	-45.73
	4460	117.46	-46.32
	4780	117.69	-46.12
	5100	118.[illegible]9	-45.92
	5420	118.69	-45.73
	5740	117.69	-46.04
	6060	118.09	-45.84
	6380	117.89	-45.69
	6700	119.09	-45.33
	7020	118.69	-45.65
	7340	117.89	-46.12
	7660	117.10	-46.24
	7980	117.97	-45.73
	4300	118.89	-44.73
	8620	118.69	-45.13
	8940	117.69	-46.52
	9260	118.09	-46.12
	9580	118.69	-45.33
	9900	118.09	-44.93
	10220	117.30	-47.32
	10540	117.32	-50.89
	10860	118.49	-45.65
	11180	118.89	-45.73
	11500	118.49	-46.12
	11820	117.22	-46.12
	12140	118.49	-45.33
	12460	117.69	-46.52
	12780	117.24	-45.32
	12940	115.27	-47.71
	13100	111.29	-48.91
	13180	97.42	-54.67
(Failure)	13190		

TABLE 76

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
B1-21	46	113.32	-41.55
	172	109.93	-44.85
	253	109.15	-45.65
	373	109.10	-46.22
	533	108.55	-47.12
	853	108.59	-47.67
	1173	108.75	-47.65
	1493	108.57	-47.64
	1813	107.75	-47.71
	2133	109.52	-45.73
	2453	108.55	-47.32
	2773	108.79	-47.12
	3093	108.55	-47.51
	3413	108.19	-47.71
	3733	108.11	-47.75
	4053	108.21	-47.72
	4373	108.52	-47.30
	4693	108.61	-47.13
	5013	108.55	-47.25
	5333	109.02	-47.12
	5653	109.38	-47.91
	5973	109.34	-47.32
	6293	108.95	-47.48
	6613	109.22	-47.67
	6933	109.94	-46.72
	7253	110.54	-45.92
	7573	110.74	-45.73
	7933	109.74	-46.12
	8213	111.33	-45.05
	8533	110.54	-46.12
	8853	110.56	-46.84
	9173	109.94	-47.32
	9493	109.74	-47.24
	9813	110.34	-46.92
	10133	110.54	-45.92
	10453	110.74	-46.52
	10773	110.75	-46.53
	11093	110.73	-46.42
	11413	110.74	-46.52
	11733	110.54	-47.08
	12053	110.82	-47.20
	12373	110.93	-46.88
	12693	110.95	-46.72
	13013	111.25	-46.84
	13333	110.85	-47.00
	13653	111.33	-46.64

TABLE 76 Continued

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
B1-21 Cont'd	13973	110.89	-47.04
	14293	111.01	-47.24
	14613	111.33	-46.92
	14773	112.33	-46.12
	14813	113.32	-47.73
(Failure)	14849		

TABLE 77

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-23	40	122.86	-33.00
	100	120.64	-35.79
	140	119.76	-36.66
	180	119.28	-37.97
	260	118.49	-39.09
	420	117.10	-39.76
	580	115.31	-40.56
	900	114.71	-42.74
	1220	114.70	-42.15
	1540	114.12	-42.15
	1860	113.72	-42.16
	2180	113.80	-42.54
	2506	112.60	-43.74
	2820	113.94	-43.34
	3140	113.72	-43.14
	3400	114.51	-42.54
	3780	113.52	-43.06
	4140	113.60	-43.34
	4420	113.72	-43.32
	4740	114.19	-42.94
	5060	114.51	-42.54
	5380	113.72	-43.06
	5700	114.43	-43.26
	6020	114.59	-42.23
	6340	113.52	-43.54
	6660	114.31	-43.34
	6980	114.47	-42.94
	7300	113.72	-43.14
	7620	113.72	-43.42
	7940	114.12	-43.14
	8260	114.71	-43.10
	8580	114.87	-42.54
	8900	114.51	-42.56
	9220	114.91	-42.74
	9540	114.52	-42.94
	9860	114.71	-43.14
	10180	114.91	-42.50
	10500	114.91	-42.62
	10820	114.71	-43.14
	11140	114.75	-42.50
	11460	114.79	-43.02
	11780	114.59	-42.90
	12100	114.51	-43.34
	12420	114.75	-43.26

TABLE 77 Continued

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-23 Cont'd	12740	114.60	-43.02
	13060	114.91	-42.94
	13380	114.59	-42.90
	13700	113.24	-43.66
	14020	114.95	-43.34
	14340	114.83	-42.88
	14660	113.72	-43.54
	14980	113.32	-43.74
	15300	113.56	-47.67
	15460	113.36	-43.74
	15624	114.71	-43.62
	15780	113.32	-43.34
	15860	112.13	-43.82
	15900	111.93	-44.14
	15990	108.95	-47.32
(Failure)	15952		

TABLE 78

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-21	20	116.90	-25.84
	60	115.35	-27.83
	100	115.11	-27.87
	300	112.13	-29.94
	500	112.17	-30.30
	700	111.65	-30.82
	1100	112.41	-30.62
	1580	112.92	-29.98
	2060	111.81	-30.62
	2540	[illegible]	-29.82
	3020	[illegible]	-29.80
	3500	111.93	-31.01
	3980	112.01	-30.62
	4460	111.81	-30.22
	4940	112.33	-30.62
	5420	111.97	-30.42
	5900	112.25	-29.98
	6380	111.93	-31.01
	6860	112.09	-31.13
	7340	111.81	-30.70
	7820	112.33	-30.78
	8300	112.45	-29.90
	8780	113.00	-29.82
	9260	112.92	-30.93
	9740	112.37	-30.70
	10220	112.52	-30.62
	10700	112.72	-30.97
	11180	112.94	-29.94
	11660	113.32	-29.62
	12140	112.13	-30.58
	12620	111.97	-30.62
	13100	112.01	-30.78
	13580	112.05	-30.89
	14060	112.33	-30.62
	14540	113.32	-29.70
	15020	112.72	-30.22
	15500	113.12	-29.70
	15980	113.72	-29.22
	16460	112.52	-29.90
	16940	112.54	-30.02
	17420	113.40	-29.22
	17900	113.32	-29.78
	18380	113.12	-29.42
	18860	113.20	-29.90
	19340	112.56	-30.22

TABLE 78 Continued

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-21 Cont'd	19820	112.52	-30.42
	20300	113.36	-29.82
	20780	113.72	-30.02
	21260	112.72	-29.86
	21740	112.56	-29.82
	22220	111.93	-31.41
	22700	111.92	-31.01
	23180	112.72	-30.62
	23660	111.53	-31.47
	24140	112.13	-31.15
	24620	113.20	-30.34
	25100	112.03	-31.53
	25580	112.17	-30.85
	26060	113.92	-29.42
	26540	113.24	-30.22
	27020	112.33	-29.62
	27500	112.13	-30.34
	27980	112.92	-29.74
	28460	113.12	-30.38
	28940	111.73	-31.41
	29420	111.70	-31.17
	29900	112.72	-30.62
	30380	112.05	-30.82
	30860	112.13	-31.41
	31340	112.05	-31.17
	31820	112.52	-30.62
	32300	112.92	-30.60
	32780	111.73	-31.49
	33260	111.77	-31.61
	33740	113.00	-30.62
	34220	111.93	-31.41
	34700	111.73	-31.61
	35180	112.17	-31.01
	35660	111.97	-30.85
	36140	111.73	-31.61
	36620	111.53	-31.73
	37100	111.73	-31.45
	37580	111.93	-31.09
	38060	112.13	-31.69
	38540	111.57	-31.73
	39020	111.73	-31.49
	39500	112.92	-30.62
	39980	111.93	-31.41
	40460	111.73	-31.72
	40940	112.29	-31.33

TABLE 78 Continued

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-21 Cont'd	41420	112.13	-31.41
	41900	111.45	-31.81
	42380	111.57	-31.77
	42860	112.13	-31.33
	43340	111.73	-31.61
	43820	111.65	-31.76
	44300	111.41	-31.41
	44780	111.93	-31.31
	45260	112.09	-31.41
	45740	111.33	-31.69
	46220	111.53	-31.80
	46700	112.45	-30.97
	47180	111.41	-31.73
	47660	111.35	-31.69
	48140	112.33	-30.97
	48620	112.41	-30.77
	49100	111.81	-31.21
	49580	111.33	-31.41
	49780	111.30	-31.21
	49940	108.15	-32.01
	49980	107.36	-31.93
	50020	106.84	-32.25
	50060	106.37	-33.00
	50100	103.38	-34.39
	50140	99.01	-35.79
(Failure)	50162		

TABLE 79

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-5	40	115.63	-19.56
	90	114.59	-19.96
	130	114.51	-20.28
	170	113.32	-21.47
	330	111.33	-23.82
	530	111.93	-22.74
	930	112.41	-23.06
	1330	110.74	-24.25
	1730	109.94	-25.65
	2330	110.54	-24.45
	2930	109.54	-24.25
	3530	111.32	-23.86
	4130	110.74	-24.21
	4730	111.37	-23.84
	5330	110.62	-23.94
	5930	111.34	-23.38
	6530	110.79	-23.86
	7130	111.65	-22.35
	7730	111.17	-23.82
	8330	111.65	-22.58
	8930	111.93	-23.78
	9530	111.45	-22.47
	10130	111.25	-23.76
	10730	111.33	-22.86
	11330	111.32	-23.34
	11930	111.45	-23.77
	12530	111.85	-22.27
	13130	111.30	-23.06
	13730	112.13	-21.79
	14330	112.14	-21.75
	14930	111.73	-22.74
	15530	111.75	-22.98
	16130	111.94	-23.23
	16730	111.93	-22.07
	17330	111.28	-23.78
	17930	110.74	-24.17
	18530	111.01	-23.89
	19130	111.34	-23.82
	19730	111.37	-23.26
	20330	112.05	-22.66
	20930	112.33	-22.07
	21530	112.17	-21.87
	22130	110.93	-23.86
	22730	111.13	-23.90
	23330	111.32	-23.66

TABLE 79 Continued

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-5 Cont'd	23930	111.25	-23.84
	24530	111.01	-24.06
	25130	111.13	-24.05
	25730	110.94	-23.94
	26330	110.74	-23.86
	26930	111.54	-23.90
	27530	111.30	-23.06
	28130	111.33	-22.86
	28730	111.31	-22.95
	29330	111.25	-23.26
	29930	110.22	-23.84
	30530	111.30	-23.38
	31130	111.33	-22.66
	31730	110.54	-23.22
	32330	110.74	-23.16
	32930	111.31	-23.74
	33530	111.73	-23.18
	34130	113.37	-20.68
	34730	112.72	-20.28
	35330	112.41	-21.07
	35930	113.72	-20.48
	36530	114.51	-20.08
	37130	114.59	-20.06
	37730	114.12	-20.28
	38330	113.72	-20.32
	38930	113.40	-20.36
	39530	113.72	-20.28
	40130	113.92	-19.96
	40730	114.12	-20.28
	41330	114.51	-19.92
	41930	115.11	-19.84
	42530	115.15	-19.68
	43130	114.35	-20.08
	43730	114.12	-20.26
	44330	114.71	-19.87
	44930	115.31	-19.56
	45530	114.51	-20.04
	46130	114.71	-19.88
	46730	113.72	-20.48
	47330	114.91	-19.92
	47930	114.59	-19.96
	48530	114.99	-19.89
	49130	114.67	-19.96
	49730	114.79	-19.92
	50330	114.83	-19.84

TABLE 79 Continued

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-5 Cont'd	50930	115.27	-19.68
	51530	114.55	-19.96
	52130	113.72	-20.28
	52330	114.12	-20.24
	53330	114.12	-19.90
	53930	114.31	-20.28
	54530	113.12	-20.86
	54690	113.72	-19.96
	55290	113.70	-19.92
	55890	114.31	-19.90
	56490	114.12	-19.94
	57090	112.33	-21.47
	57690	113.24	-20.20
	58290	112.13	-20.99
	58890	112.10	-20.28
	59490	111.93	-20.40
	60090	111.85	-20.68
	60690	112.01	-20.60
	61290	112.12	-20.06
	61890	113.20	-19.88
	62490	111.73	-20.48
	62490-77240 - No data.		
	77240	113.32	-20.04
	77320	112.92	-20.44
	77920	114.51	-19.95
	78520	114.75	-19.87
	79120	112.52	-21.87
	79720	110.93	-23.82
	80320	111.32	-23.34
	80920	111.57	-23.06
	81520	111.35	-23.26
	82120	111.73	-22.74
	82720	111.70	-22.27
	83320	110.14	-23.86
	83520	108.15	-24.65
	83720	107.15	-25.69
	83800	104.97	-27.51
	83880	102.98	-28.43
	83920	101.59	-29.82
	83960	99.40	-31.41
(Failure)	83964		

TABLE 80

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-31	1	131.01	-108.15
	4	135.19	-118.49
	8	134.39	-119.60
	15	134.19	-121.67
	21	132.60	-123.18
	27	131.61	-123.26
	34	134.39	-123.24
	48	134.41	-123.30
	63	131.01	-123.58
	75	130.89	-123.60
	88	130.02	-123.78
	104	129.78	-123.66
	117	129.26	-123.70
	130	129.07	-123.58
	144	127.83	-124.10
	159	127.63	-123.69
	171	127.44	-124.25
	184	127.83	-123.65
	200	127.24	-123.98
	213	127.51	-123.28
	226	127.20	-123.58
	240	127.22	-123.46
	255	126.64	-124.25
	267	127.04	-123.70
	280	126.52	-124.06
	296	126.16	-123.66
	309	124.85	-123.98
	322	123.86	-123.66
	336	123.66	-123.64
	349	123.26	-124.06
	351	123.04	-124.45
	356	122.86	-124.06
	357	122.66	-124.16
	(Failure) 358		-124.10

TABLE 81

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-32	1	121.27	-91.65
	3	123.26	-102.39
	8	121.07	-107.32
	16	119.68	-109.34
	32	119.26	-110.70
	56	118.09	-111.01
	80	116.50	-111.29
	104	115.71	-111.33
	128	115.59	-111.34
	152	115.71	-111.35
	176	115.31	-111.33
	200	115.30	-111.34
	224	115.29	-111.33
	248	114.59	-111.53
	272	114.71	-111.52
	296	113.92	-111.65
	320	113.52	-111.41
	344	113.72	-111.31
	348	112.92	-111.53
	392	113.72	-111.41
	416	112.55	-111.53
	440	112.13	-111.34
	464	111.73	-111.35
	488	111.65	-111.30
	512	111.33	-111.32
	536	109.74	-111.35
	560	107.58	-111.53
	584	103.98	-111.73
	600	100.60	-111.41
	607	96.62	-111.93
	(Failure) 608	92.25	

TABLE 82

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-4	14	127.24	-113.72
	37	126.24	-115.11
	75	123.26	-117.30
	112	123.46	-115.71
	146	120.68	-118.05
	181	119.28	-117.65
	214	119.29	-116.30
	250	117.69	-118.49
	286	119.48	-115.31
	322	119.28	-115.39
	358	119.48	-115.31
	394	116.30	-116.90
	430	117.10	-115.43
	466	116.10	-115.35
	502	115.35	-115.27
	538	115.15	-115.22
	574	112.13	-115.43
	610	110.74	-117.10
	622	108.15	-116.90
	633	106.76	-118.49
	(Failure) 634	103.18	

TABLE 83

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-33	1	120.08	-75.55
	2	119.88	-83.30
	8	114.51	-91.41
	14	113.12	-92.25
	20	111.93	-93.84
	38	107.55	-95.03
	62	111.35	-93.92
	86	111.33	-93.44
	110	111.73	-92.05
	134	111.70	-91.85
	158	111.75	-91.45
	182	111.93	-91.53
	206	111.89	-91.41
	230	112.05	-91.13
	254	111.33	-91.45
	278	110.74	-92.25
	302	110.67	-92.84
	326	110.60	-91.85
	350	111.32	-91.05
	374	111.73	-90.62
	398	118.49	-89.07
	422	115.11	-89.54
	446	111.73	-89.86
	470	112.13	-89.07
	494	112.33	-88.35
	518	111.65	-89.46
	543	111.29	-91.41
	569	110.54	-91.49
	595	109.94	-91.85
	621	110.34	-91.45
	647	111.32	-90.46
	673	111.73	-88.07
	699	112.13	-87.67
	725	114.23	-91.53
	751	113.72	-87.08
	777	113.32	-87.12
	803	113.72	-90.66
	829	112.13	-87.08
	855	111.33	-88.27
	881	111.30	-89.08
	907	110.54	-89.86
	933	110.74	-89.86
	959	111.01	-88.47
	950	110.83	-88.27

TABLE 83 Continued

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-33 Cont'd	985	124.06	-86.28
	1011	121.27	-87.45
	1037	110.74	-88.87
	1061	110.14	-87.87
	1085	108.07	-88.65
	1109	107.36	-90.06
	1133	109.17	-91.49
	1158	101.59	-92.25
	1164	99.80	-93.44
	1171	95.43	-94.83
(Failure)	1174		

TABLE 84

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-10	1	120.78	-58.25
	2	119.60	-66.90
	8	113.32	-73.56
	14	112.13	-74.52
	20	111.37	-75.94
	38	111.13	-78.53
	68	109.34	-78.73
	98	108.09	-79.52
	128	107.83	-79.32
	158	107.67	-79.56
	188	107.28	-79.60
	218	107.36	-79.84
	248	106.96	-79.72
	278	106.90	-79.88
	308	106.16	-80.12
	338	106.56	-79.92
	368	106.54	-79.64
	398	106.96	-79.84
	428	105.96	-80.12
	458	106.88	-79.60
	488	105.61	-79.52
	518	105.45	-79.54
	548	105.84	-79.52
	578	105.37	-79.54
	608	105.41	-79.60
	638	104.73	-80.00
	668	104.17	-80.24
	698	104.15	-80.20
	728	104.57	-80.72
	758	104.10	-80.99
	788	104.14	-81.51
	818	103.78	-81.31
	848	103.38	-81.59
	878	103.42	-80.91
	908	103.37	-79.90
	938	103.90	-80.12
	968	103.38	-80.72
	998	103.36	-81.19
	1028	103.30	-81.11
	1058	103.32	-81.51
	1088	103.37	-81.71
	1118	103.34	-81.63
	1148	103.34	-81.55
	1178	103.42	-80.20
	1208	103.22	-81.11

TABLE 84 Continued

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
2-10 Cont'd	1238	103.38	-80.80
	1268	102.78	-81.71
	1298	102.98	-81.83
	1328	103.26	-81.91
	1358	103.18	-82.07
	1388	102.76	-81.82
	1418	103.28	-82.31
	1448	102.98	-81.67
	1478	102.90	-81.47
	1508	102.94	-81.52
	1538	102.39	-81.61
	1568	101.89	-81.51
	1598	102.41	-81.50
	1628	101.79	-81.11
	1658	101.19	-80.91
	1688	101.93	-80.52
	1718	101.39	-81.12
	1748	101.87	-79.92
	1778	101.79	-79.88
	1808	101.07	-80.04
	1838	101.59	-80.12
	1868	101.49	-80.32
	1898	101.19	-80.30
	1928	101.20	-80.31
	1958	100.20	-80.00
	1988	100.24	-80.32
	2018	99.80	-80.32
	2048	99.44	-81.11
	2078	99.40	-81.31
	2108	99.36	-82.13
	2138	98.81	-82.90
	2168	97.89	-82.91
	2198	96.82	-83.50
	2228	95.83	-83.54
	2258	95.39	-83.53
	2288	94.83	-83.62
	2318	99.44	-85.49
	2336	86.88	-89.07
	2341	75.67	-89.66
	2342	73.56	-89.86
(Failure)	2346		

TABLE 85

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-28	1	117.30	-40.32
	2	113.92	-46.92
	5	108.15	-54.47
	10	106.16	-55.86
	16	104.77	-56.86
	28	100.20	-58.05
	47	103.78	-58.05
	102	103.98	-58.45
	157	103.75	-58.05
	212	103.58	-58.53
	267	103.38	-59.60
	322	103.36	-59.64
	377	103.22	-59.60
	432	99.20	-59.24
	487	99.01	-59.32
	542	102.39	-58.85
	597	102.58	-59.59
	652	101.79	-59.66
	707	101.55	-59.84
	762	100.99	-60.04
	817	99.01	-60.24
	872	97.61	-61.23
	927	99.36	-60.03
	982	99.40	-59.66
	1037	99.42	-59.67
	1092	98.81	-60.64
	1147	98.41	-60.20
	1202	98.21	-60.83
	1257	99.20	-60.04
	1312	99.05	-61.19
	1367	98.97	-60.44
	1422	98.93	-60.04
	1477	97.89	-60.83
	1532	98.21	-60.44
	1587	97.73	-57.57
	1642	97.42	-62.03
	1697	98.61	-60.16
	1752	97.88	-60.02
	1809	97.42	-60.64
	1864	98.01	-60.44
	1919	98.21	-59.84
	1974	98.81	-59.64
	2029	99.38	-59.60
	2084	98.85	-59.64
	2139	99.24	-59.62

TABLE 85 Continued

SAMPLE	CYCLES	TENSILE STRESS (KSI)	COMPRESSIVE STRESS (KSI)
3-28 Cont'd	2194	99.20	-59.24
	2249	99.36	-59.64
	2304	99.39	-59.62
	2359	98.61	-60.04
	2414	100.20	-58.85
	2469	99.41	-59.62
	2524	99.24	-59.68
	2577	99.20	-59.72
	2632	96.22	-61.23
	2687	95.63	-63.22
	2742	97.65	-61.43
	2797	97.50	-61.63
	2852	97.42	-62.03
	2907	96.70	-62.03
	2962	95.83	-63.42
	3017	95.83	-61.23
	3072	97.10	-62.03
	3120	96.42	-62.43
	3182	96.22	-63.02
	3237	95.63	-63.62
	3292	95.35	-63.94
	3347	96.14	-63.50
	3402	100.12	-61.27
	3426	103.38	-60.40
	3432	103.46	-60.42
	3438	106.64	-60.40
(Failure)	3442		

REFERENCES

1. J. B. Conway and R. H. Stentz, "High-Temperature, Low-Cycle-Fatigue Data for Three High-Strength Superalloys," to be published as an Air Force Wright Aeronautical Laboratory Technical Report.

2. M. N. Menon, "Life Prediction Techniques for Analyzing Creep-Fatigue Interaction in Advanced Nickel-Base Superalloys," AFML-TR-76-172 (Air Force Materials Laboratory, Wright-Patterson AFB, OH, 1976).

3. J. M. Hyzak and H. L. Bernstein, "An Analysis of the Low Cycle Fatigue Behavior of the Superalloy René 95 by Strainrange Partitioning," AGARD-CP-243 (Advisory Group for Aerospace Research and Development, London, 1978), pp. 11-1 through 11-25.

4. H. L. Bernstein, "An Evaluation of Four Current Models to Predict the Creep-Fatigue Interaction in René 95," AFML-TR-79-4075 (Air Force Materials Laboratory, Wright-Patterson AFB, OH, 1979).

5. J. M. Hyzak, "Effects of Defects on the Fatigue Crack Initiation Process in Two PM Superalloys," Ph.D. Thesis (Carneigie-Mellon Univ., Pittsburgh, PA, 1979).

6. C. E. Shamblen, R. E. Allen, and F. E. Walker, "Effect of Processing and Microstructure on René 95," Metallurgical Transactions 6A, 2073 (November 1975).

7. M. N. Menon, "Metallographic Characterization of René 95 Forgings," AFML-TR-73-180 (Air Force Materials Laboratory, Wright-Patterson AFB, OH, 1973).

8. T. Slot, R. H. Stentz, and J. T. Berling, "Controlled-Strain Testing Procedures," in Manual on Low Cycle Fatigue Testing, ASTM STP 465 (American Society for Testing and Materials, Philadelphia, PA, 1969), pp. 100-128.

9. J. B. Conway, R. H. Stentz, and J. T. Berling, Fatigue, Tensile, and Relaxation Behavior of Stainless Steels, TID-26135 (Oak Ridge National Laboratory, Oak Ridge, TN, 1975), pp. 14-31.

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